Deliverable D6.3

Report on the external stakeholder engagements conducted at the start of the PRHYDE project – Surveys and Workshop 1

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Authors:

N. Hart (ITM Power)

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R E P O R T

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ACRONYMS AND ABBREVIATIONS

APRR	Average Pressure Ramp Rate
CHSS	Compressed Hydrogen Storage System
H_2	Hydrogen
HDV	Heavy Duty Vehicle
NWP	Nominal Working Pressure
PTarget	Target pressure (term from SAE J2601)
RCS	Regulations, Codes and Standards
SoC	State of Charge
WP	Work Package
WS	Workshop

1 INTRODUCTION

This document captures the efforts in the early stages of the PRHYDE project to enable the project consortium to seek input from outside of the project, and enable external stakeholders to give feedback to be considered, by conducting a series of small surveys at the start of the project.

Additionally, in order to broaden the awareness of the project with external stakeholders, disseminate the anticipated activities to be carried out within the project and enable external stakeholders to give feedback to be considered, workshops / webinars we conducted.

As can be seen in Figure 1 below, two in-person workshops were scheduled to be carried out within the first 5 months of the project:

- Workshop 1: Scheduled for either month 2 or 3 – in order to explain the anticipated activities within the project, and start to gather input for the early stage WP2 and WP3 deliverables (and if appropriate WP4 and WP5). Details on this workshop and feedback received are covered in this Deliverable D6.3.
- Workshop 2: Scheduled for either month 4 or 5 – in order to present and explain the first deliverables from the project, and gather any final input needed for the first stages of the project. (Further information on this workshop is provided in the PRHYDE Deliverable D6.4 [1])

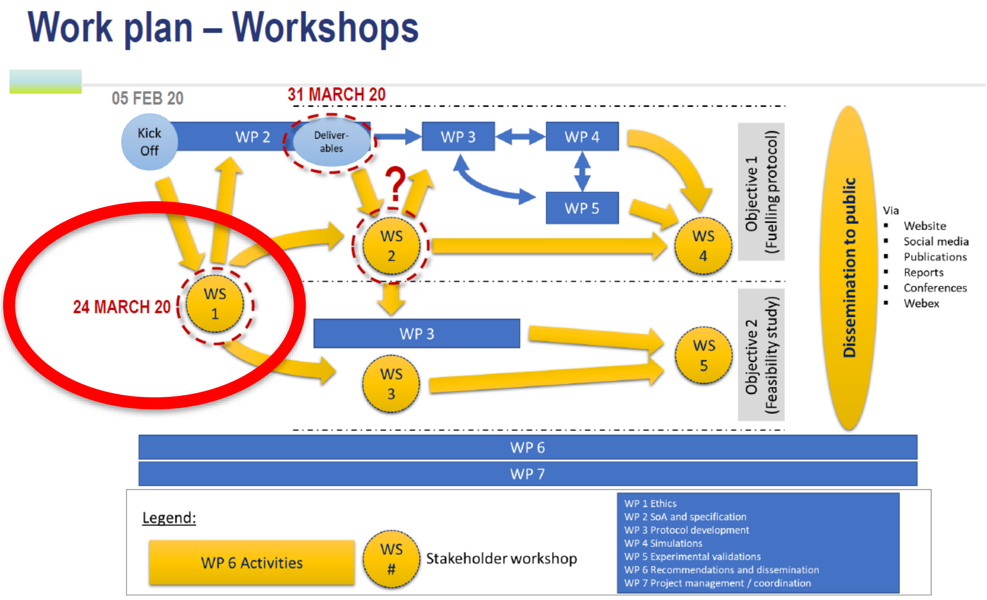

Figure 1: PRHYDE work plan – initial workshops supporting the work of WP2, whilst also disseminating the project goals, and anticipated activities to external stakeholders

[1] Deliverable D6.4 "Report on the external stakeholder engagements conducted at the start of the PRHYDE project –Workshop 2" is available on the PRHYDE website at https://prhyde.eu/progress/.

The original intention was for these events to be highly “interactive” in-person workshops, however due to developments with the Covid-19 coronavirus, it was necessary to move these to being solely Web-based meetings, essentially a much shorter webinar in each case. These consisted of a series of presentations from the consortium, and selected invited guests, and then allowed limited time for people to ask a small number of questions.

The questions raised during (and after) the first webinar, following the presentations given, are captured in this document, along with answers following consideration by the PRHYDE consortium.

The intention of this document is to capture a variety of aspects from the external stakeholder engagement:

- the survey, and references to other PRHYDE Deliverables [2] where summarised responses have been documented);
- a brief report from the first webinar, the presentations given, and the questions raised during the webinar.

[2] Deliverables of WP2 “State-of-the-Art” are available on the PRHYDE website at https://prhyde.eu/progress/.

2 "PRHYDE: State of the Art Analysis –Surveys"

The following survey (see chapters 2.1, 2.2 and 2.3) was circulated to the PRHYDE mailing list between February and April 2020 in order to capture input from wider industry and stakeholders.

2.1 Introductory text

As part of the "Protocol for heavy-duty hydrogen refuelling" (PRHYDE) FCH JU funded project, we are assessing the State of the Art when it comes refuelling protocols for medium and heavy-duty vehicles.

To try to ensure that the protocols developed within the project, and any recommendations coming out from the project, are relevant to as many stakeholders as possible, we would like to understand the wider picture when it comes to current status of refuelling equipment, protocols, and the vehicles to be fuelled.

As such, the consortium have prepared a couple of short surveys to try to identify the state of the art when it comes to refuelling protocols for medium and heavy-duty vehicles, and related aspects – the design of infrastructure, vehicles, and also aspirational plans for the future of medium and heavy-duty hydrogen vehicles and their refuelling.

It would be greatly appreciated if everyone involved in, or with an interest in, medium and heavy-duty vehicle refuelling could please take a look at the questions below, if at all possible complete any relevant sections of the survey and send a response (in the form of an amended word document ideally) back to us (at info@prhyde.eu) by Friday 20th March.

We hope to be able to present the information on the 24th March.

At this time, we don't have anything in place to be able to deal with confidential information from outside of the consortium, although if this would be necessary to share further information that you believe could be critical to the efforts within PRHYDE, please let us know, and we'll endeavour to find a solution.

Many thanks in advance.

2.2 Hydrogen refuelling infrastructure providers, operators and users

A) General questions:

1) What experience do you have of refuelling protocols for hydrogen vehicles? (e.g. a manufacturer, operator, user, other)
2) What gaps/issues do you consider there to be with the existing protocols in use today, whether for light, medium or heavy duty road vehicles?
3) What types of fuelling protocols do you offer (manufacturer)/ have knowledge of (operator/user) for compressed (gaseous) hydrogen vehicles with a high pressure

hydrogen storage capacity greater than ~250 litres? (i.e. greater than 6 kg @ 35 MPa NWP or 10 kg @ 70 MPa NWP – the SAE J2601 definition of "light duty")

For instance – do you use a table based approach with pressure control [MPa/min APRR and PTarget] or do you use mass flow control / fixed orifice / other?

B) If a manufacturer of a refuelling point with a fuelling protocol(s) for medium of heavy duty vehicles:

1) Do you make an assumption that a particular vessel type will be used in the vehicle, or is the fuelling protocol considered suitable for all types of tanks? If you have different protocols for different types of tanks, how does the station differentiate between them?
2) Have you ever carried out any modelling on the protocol and the thermal effect on the vessel(s) receiving the hydrogen?
3) Do you use (or anticipate using) hydrogen pre-cooling for fuelling of vehicles with a storage capacity >250 litres?
4) Do you have options for refuelling liquid / cryo-compressed hydrogen? If so, what limitations are there in the protocol regarding the vehicle storage system capacity?
5) What dispensing specific components (e.g. nozzle, hose, breakaway, flow meter, pre-cooling if applicable) do you use for gaseous hydrogen high flow dispensing (defined in this case as >60g/s) and do you find any issues with these components?

C) Further general questions:

1) SAE J2601 (to be published 2020) now includes an example "standard" fuelling protocol for 700 bar NWP vehicles with storage capacity above 250 litres (10kg):
    a. if a refuelling station (or refuelling point) manufacturer, would you anticipate providing this to a customer?
    b. if a refuelling station operator, would you find this useful to be able to buy a refuelling point with this capability?
    c. would you prefer to see this fuelling protocol integrated into a "light duty" vehicle refuelling point, or as a stand-alone refuelling point?
    d. would you like to see an equivalent for 350 bar NWP vehicle fuelling?
2) Have you considered fuelling of medium or heavy duty vehicles to a NWP of 500 bar? (or other pressures)
3) If so, what do you see as being the benefits of refuelling at this pressure?
4) Also, what constraints have you found with the components on the market currently?

Do you have any further comments / issues to raise regarding fuelling of medium or heavy duty vehicles?

2.3 Hydrogen vehicle manufacturers (road/marine/rail/other)

1) What compressed hydrogen storage systems (CHSS) are currently in use on your existing gaseous hydrogen medium or heavy duty vehicles, and what are their boundary conditions? (e.g. total and individual tank volumes, design temperature, design pressure, number of design cycles, etc.)
2) What CHSS do you anticipate using for future gaseous hydrogen medium or heavy duty vehicles, and what would you expect their boundary conditions to be? (e.g. total and individual tank volumes, design temperature, design pressure, number of design cycles, etc.)
3) How do you anticipate installation of the storage vessels to influence the ability of the vessel to dissipate heat gained during fuelling?
4) What hydrogen storage systems are currently in use on existing non-gaseous (i.e. liquid, cryo-compressed, etc) hydrogen heavy duty vehicles, and what are their boundary conditions?
5) What hydrogen storage systems do you anticipate using for future non-gaseous (i.e. liquid, cryo-compressed, etc) hydrogen heavy duty vehicles, and what would you expect their boundary conditions to be?
6) What (ideal) targets are anticipated for future protocols? (e.g. filling a train in X minutes)
7) Which are the main factors currently limiting future fuelling protocol performance? Do you anticipate a way by which these factors could be expected to improve?
8) What other considerations can be accounted for to facilitate fuelling of medium and heavy-duty vehicles? (e.g. multiple systems being filled at the same time on the same vehicle in parallel)
9) What refuelling related components (e.g. receptacle, communications equipment, etc.) do you use for gaseous hydrogen high flow dispensing (defined in this case as >60g/s) and do you find any issues with these components?
10) What gaps have you encountered in the capabilities of existing refuelling related components on the market, including those required for interoperability?
11) Do you have any further comments / issues to raise regarding fuelling of medium or heavy duty vehicles?

3 WORKSHOP 1 REPORT

Held on the 24th March 2020, this workshop included presentations from the four work package leaders, and a number of State-of-the-Art related presentations, given by members of the consortium, or invited guests.

3.1 Agenda

The agenda is included below:

Timing (approx.)	**Subject**	**Presenter**
13:45	*Join webinar*	
14:00	Introduction to project	Martin Zerta
14:10	Intentions of the project – detailed explanations for feedback / discussion: *i. State of the Art (incl. surveys)* *ii. General description of protocols to be developed* *iii. Modelling / simulations* iv. *Testing* *Submitted questions*	i. Paul Karzel ii. Claus Sinding iii. Fouad Ammouri iv. Antonio Ruiz
14:50	Current status regarding medium and heavy duty vehicles, including specifics on the hydrogen storage systems and refuelling system components used, also RCS requirements *i. General* *ii. Survey responses* *iii. Nikola* *iv. Faun* *v. ULEMCo ** *vi. Toyota*	i. Paul ii. Nick Hart iii. Antonio iv. Georg Sandkühler v. Sean O'Kane vi. Vincent Mattelaer, Jacki Birdsall
15:20	*Comfort break (10 minutes)*	

*(In the event, Sean O'Kane wasn't able to join due to technical difficulties, so this presentation wasn't given)

15:30	Current status regarding refuelling protocols for light, medium and heavy duty vehicles, including RCS requirements i. *General* ii. *Status SAE standards* ○ *SAE J2600* ○ *SAE J2601 (CHSS Cat D)* ○ *SAE J2601-2* iii. *Survey responses* iv. *NEL* v. *Air Products* vi. *CEP (Germany)* vii. *HySpeed project (Netherlands)*	i. Paul, Vincent ii. Nico Bouwkamp & Steve Mathison iii. Nick iv. Claus v. Joe Cohen vi. Benjamin Coiffier, Air Liquide / CEP vii. Roel de Natris, TNO
16:00	State of the Art regarding dispensing system components used for medium and heavy duty vehicle fuelling stations i. *General* ii. *Survey responses* iii. *Status H70 HF*	i. Paul, Nick ii. Nick iii. Claus
16:20	General discussion / submitted questions: • *Any required modifications to the plans for the project* • *Requirements for future protocols*	
16:50	Summary and next steps	
17:00	*End*	

Approximately 130 people attended the workshop.

The questions raised during, and after the first workshop are attached as Annex 1. Where possible, answers or responses to these questions are included – others will be looked at in the WP2 Deliverable D2.6 if possible.

3.2 Dissemination

A number of the presentations are available on the PRHYDE website (https://prhyde.eu/events/):

Workshop 1 – PRHYDE presentation slides https://prhyde.eu/wp-content/uploads/2020/05/2020-03-24_PRHYDE-WS_v3.4-with-additional-slides-updated-1.pdf
Survey responses (summary) https://prhyde.eu/wp-content/uploads/2020/05/2020-03-24_PRHYDE-WS-Survey-responses-v1.1.pdf
Status SAE standards https://prhyde.eu/wp-content/uploads/2020/05/2020-03-24_PRHYDE-15_30-SAE.pdf
Vehicle to Station Communications – Air Products https://prhyde.eu/wp-content/uploads/2020/05/2020-03-24_PRHYDE-15_30-Air-Products-2.pdf

The rest have been provided to the PRHYDE contact list, but permission was not granted for them to be shared publicly.

4 SUMMARISED SURVEY RESPONSES RECEIVED

The responses to the surveys were split into 3 sections, those relevant to the three WP2 deliverables D2.1, D2.3 and D2.4.

4.1 D2.1 related

Feedback received from participants of the workshops and survey responders on ideal targets for future refuelling protocol performance is included in Deliverable D2.1 [3] as Annex 1.

4.2 D2.3 related

Feedback received from participants of the workshops and survey responders on ideal future refuelling protocol characteristics is included in Deliverable D2.3 [4] as Annex 1.

4.3 D2.4 related

Feedback received from participants of the workshops and survey responders on existing hardware that is critical to, or defines the requirements for, refuelling is included in Deliverable D2.4 [5] as Annex 1.

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[3] Deliverable D2.1 “Performance metrics for refuelling protocols for heavy duty hydrogen vehicles” is available on the PRHYDE website at https://prhyde.eu/progress/.

[4] Deliverable D2.3 “Gap analysis of existing heavy duty gaseous hydrogen vehicle refuelling protocols” is available on the PRHYDE website at https://prhyde.eu/progress/.

[5] Deliverable D2.4 “Gap analysis of existing hardware used for heavy duty gaseous hydrogen vehicle refuelling” is available on the PRHYDE website at https://prhyde.eu/progress/.

5 CONCLUDING REMARKS

The disruption that the Covid-19 coronavirus caused to the planned schedule for interaction with external stakeholders created difficulties in arriving at a situation where the types of conversations that had been hoped for were able to take place, however, from a perspective of dissemination of the project goals and activities, the workshops were extremely successful, and seemingly positively received.

In order to ensure that the needs for as many key external stakeholders as possible are taken into account however, a different approach to that originally anticipated will be necessary. It is hoped that the series of smaller workshops will enable this.

6 RECOGNITION

The PRHYDE consortium would like to recognise the input from external stakeholders, who responded with completed surveys:

- Transport for London
- Air Products
- TÜV SÜD NEL
- Audi
- Faun Umwelttechnik GmbH
- ULEMCo
- H2M
- Hexagon
- SNCF
- Maximator
- TUGraz
- Green Planet
- Colruyt Group
- McPhy
- CMB Tech
- Stottler Development, LLC
- Pitpoint
- The State of California
- Alstom
- CaFCP
- H2Nova
- CNIS
- H2 Energy AG
- Daimler Truck AG
- GreenGT
- Arcola Energy
- NanoSUN
- Institut für Innovative Technologien Bozen

What is PRHYDE?

With funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2 JU), the PRHYDE project is aiming to develop recommendations for a non-proprietary heavy duty refuelling protocol used for future standardization activities for trucks and other heavy duty transport systems applying hydrogen technologies.

Based on existing fuelling protocols and current state of the art for compressed (gaseous) hydrogen fuelling, different hydrogen fuelling protocols are to be developed for large tank systems with 35, 50, and 70 MPa nominal working pressures using simulations as well as experimental verification. A broad industry perspective is captured via an intense stakeholder participation process throughout the project.

The work will enable the widespread deployment of hydrogen for heavy duty applications in road, train, and maritime transport. The results will be a valuable guidance for station design but also the prerequisite for the deployment of a standardized, cost-effective hydrogen infrastructure.

Further information can be found under https://www.prhyde.eu. For feedback on the PRHYDE project or the published deliverables, please contact info@prhyde.eu.

PRHYDE Project Coordinator

Ludwig-Boelkow-Systemtechnik GmbH
Daimlerstr. 15, 85521 Ottobrunn/Munich, Germany
http://www.lbst.de

Members of the PRHYDE Consortium

APPENDIX A: QUESTIONS RECEIVED DURING / AFTER WORKSHOP 1

Workshop 1 participant question:

"Is there a definition for HDV?"

Addressed in part by slides by Steve Mathison – an outstanding issue.

Also see Deliverable D2.1, although worth noting that the definitions depend on geography, and different definitions are used in Europe to those in, for instance, the US.

For instance, in Europe, this question is answered succinctly by the following memo on the Commission strategy for reducing Heavy-Duty Vehicles' (HDVs) fuel consumption and CO2 emissions, prepared in the lead up to the Regulation (EU) 2019/1242 [6]

What are Heavy-Duty Vehicles?

HDVs comprise trucks, buses and coaches. HDVs are defined as freight vehicles of more than 3.5 tonnes (trucks) or passenger transport vehicles of more than 8 seats (buses and coaches). The HDV fleet is very heterogeneous, with vehicles that have different uses and drive cycles. Even trucks are segmented into several categories, including long-haul, regional delivery, urban delivery and construction.

https://ec.europa.eu/commission/presscorner/detail/en/MEMO_14_366

Further detail on the definitions of type-approved vehicles used in Europe can be found in the Directive 2007/46/EC 7 - for instance, the extract below from Annex II - Definition of vehicle categories and vehicle types:

- *Category M: Motor vehicles with at least four wheels designed and constructed for the carriage of passengers:*
- *Category M1: Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.*
- *Category M2: Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.*
- *Category M3: Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes.*

[6] Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO2 emission performance standards for new heavy-duty vehicles and amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC

[7] Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles

- *Category N: Motor vehicles with at least four wheels designed and constructed for the carriage of goods.*
- *Category N1: Vehicles designed and constructed for the carriage of goods and having a maximum mass not exceeding 3,5 tonnes.*
- *Category N2: Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 3,5 tonnes but not exceeding 12 tonnes.*
- *Category N3: Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes.*

Workshop 1 participant question:

"What nozzle are they using for the H50 dispenser? (in reference to the ZBT test station)"

H70 standard flow (i.e. up to 60 g/s) nozzle - as it is for single tank testing rather than filling an entire system)

Workshop 1 participant question:

"Why would we not test both type 3 and type 4 at the 350 bar pressure to ensure the protocol is compatible with both?"

This is certainly something to be considered, and the project has developed to look at both Type 3 and Type 4 tanks

Workshop 1 participant question:

"What type of nozzles are being used for pre-cooled H2 refuelling for type 4 tanks?"

Standard (SAE J2600) H35/H70 standard flow & H35HF nozzles

Workshop 1 participant question:

"Missing indication com / non-com refueling, what is preferred and who will take care about a proper working interface? Secondly cooled versus not cooled..."

Communications preferred, but an option will be investigated for fuelling should comms not be available / fail

Options for fuelling without precooling will be explored within the project.

Workshop 1 participant question:

“Why is 350 bar fueling in Birmingham at 60 gram/sec cooled to -40C and 120 gram/sec HF non cooled?”

Addressed during the webinar – completely different dispensing systems used at the site

Workshop 1 participant question:

“How is "freeze on" dealt with during current testing?”

Low flows for single tank testing mean that these tests will be no different to a normal light duty fuelling.

For entire system testing, then this is an issue that arises with the current nozzle / receptacle technologies.

Workshop 1 participant question:

“Is there a way to cover the influence of piping and different numbers of cylinders as well?”

These variations, and the effect of different systems, will be investigated within the modelling elements of the project, and where possible, within the practical experiments within the project.

Workshop 1 participant question:

“Are the results of experimental dependant of the on tank valve? (ie supplier dependant)”

It is anticipated that the on-tank valve is likely to influence the fuelling, and this will be explored within the project if possible.

Workshop 1 participant question:

“In PRHYDE project, how to define the simulation results is aligned with experimental results, I mean how to design the experiments to prove the accuracy of the simulation is enough.”

The planning for the experimental campaign will indicate the more “extreme” conditions needed to be tested in order to validate the modelling.

Workshop 1 participant question:

“Is the maximum temperature have you got in Fast refuelling at 700 bar with no cooling device?”

Modelling – See Deliverable 4.1 for modelling of H70 fuellings with reduced//no precooling (15 deg C ambient) – this indicated that a temperature in excess of 85 deg

C could be expected without precooling, especially in warm or hot ambient temperatures, when trying to fill a 700 bar vehicle in 10 minutes.

Actual testing – A fuelling would be stopped if it reached 85 deg C in order to protect the vehicle tanks

Workshop 1 participant question:

“What are your expectations about differences between different heavy duty applications like bus or railway fueling process?”

It seems that there will be need for larger mass flow rates of hydrogen to a train compared to current 350 bar NWP road vehicle applications. This can be partially addressed by the expectation that trains will have multiple systems (e.g. 2) on different vehicles within the train that can be filled in parallel if the infrastructure is available, however, it is likely that the current H35HF nozzles will not be adequate for these applications. CEN TC 256 WG43 is looking at the refuelling requirements for rail applications, and PRHYDE will engage with this grouping.

Workshop 1 participant question:

“Can you speak any more about the advanced communications work?”

Not part of the scope of the project – however, an anticipated topic for standardisation in ISO TC 197.

Workshop 1 participant question:

“A question to this fossil equality. How do you fix the required average autonomy ranges? It is not always so, that you need to achieve the max offered by diesel. A Scania analysis shows that 1000 km by diesel is a luxury, not a necessity, and that 400 km autonomy in most of the case are enough.”

It is likely that different vehicle designs can be expected for different applications, but vehicles intended for long range applications are expected to have a range of ~1000 km, with different dedicated vehicles for use in shorter range applications.

If however, the same vehicle (when fuelled with compressed hydrogen) is to be used for multiple applications, some with lower range requirements, by making a vehicle compatible with different dispensing pressures it could enable fuelling at stations with lower cost hydrogen at lower pressures whenever there is a wish to do so

Workshop 1 participant question:

“Question for HySpeed: Will the trucks be equipped with Type 3 or Type 4 tanks?”

Type of tanks had not been determined at the time of the presentation

Workshop 1 participant question:

"The project only define the communication protocol with several physical possible layers (IR, FC, ...)"

The method of communication is outside of the scope of the project, and the availability of suitable communications between the station and vehicle is assumed to be something that will be addressed in the future, enabling the fuelling protocol developed within PRHYDE to account for such communicated information.

Workshop 1 participant question:

"Shall we consider Type A nozzle only or also Type C?"

My understanding is that in France, the maintaining of the nozzle and hose at pressure after fuelling, the intention of ISO 17268 Type A or Type B nozzles, is not permitted. As a result, it may be the case that the general (typical) design of dispensers moves to one where everything in the fuelling assembly is vented after the fill, therefore there would be no benefit in Type A or B nozzles in the future. It seems that they can still be used (as are the only things on the market for high flow applications) but I guess that there may be no further need for them in the future?

Extract from ISO FDIS 17268: October 2019

5.2 *Nozzles shall be one of the following three types.*

a) TYPE A — A nozzle for use with dispensing hoses that may remain fully pressurized at dispenser shutdown. The nozzle shall not allow gas to flow until a positive connection has been achieved. The nozzle shall be equipped with an integral valve or valves, incorporating an operating mechanism which first stops the supply of gas and safely vents the trapped gas before allowing the disconnection of the nozzle from the receptacle. The operating mechanism shall ensure the vent connection is open before the release mechanism can be operated and the gas located between the nozzle shut-off valve and the receptacle check valve is safely vented prior to nozzle disconnection.

b) TYPE B — A nozzle for use with dispensing hoses that may remain fully pressurized at dispenser shutdown. A separate three-way valve connected directly, or indirectly, to the inlet of the nozzle shall be used to safely vent trapped gas prior to nozzle disconnection. The nozzle shall not allow gas to flow until a positive connection has been achieved. Venting shall be achieved prior to disconnection of the nozzle. External three-way valves shall be constructed and marked so as to indicate clearly the open, shut and vent positions.

c) TYPE C — A nozzle for use with dispensing hoses which are depressurized (0,5 MPa and below) at dispenser shutdown. The nozzle shall not allow gas to flow until a positive connection has been achieved. The function of preventing flow may be controlled by the dispenser as long as it is receiving a positive connection signal from the nozzle.

Workshop 1 participant question:

“Is there any advice on ensuring vehicle fuel storage piping is adequately sized to be suitable for high flow protocols? Or maximum pressure drops?”

The influence of Cv (or Kv) of the dispensing and vehicle systems on the fuelling performance will be explored in a limited way within the project from a modelling point of view.

Deliverable D4.1 shows how a Cv that is not appropriate for high flow fuelling can affect the vehicle end pressure of the fill (and SOC), when the dispenser pressure is limited to the maximum allowable pressure, due to the large pressure drop experienced.

Additional question received by email:

“The SAE J2601-2 HDV protocol doesn’t prescribe any precooling currently. In general, several solutions are applied for refuelling Heavy duty Vehicles; mostly H35 T20 or H35 Tambient. Can anything be said regarding a certain obligated precooling protocol to come?”

For public stations, the use of precooling is not obligated (by law) in Europe (through reference in the AFID to ISO TS 20100, currently, or EN 17127, future) for any type of fuelling.

There is however a need to use an appropriate method of refuelling, which can be a standardised protocol, or another approach.

Regarding standardised protocols:

To use the latest SAE J2601 standardised refuelling protocol for light duty vehicles, then this currently requires precooling.

Other options can be used if the fill time can be extended, and are being explored in SAE J2601-4 for light duty vehicles.

For public heavy duty vehicle refuelling stations, in the absence of a standardised heavy duty vehicle fuelling protocol, the protocol used needs to be acceptable for the manufacturers of vehicles using the station.

This may enable non precooled filling for certain vehicles, depending on a variety of considerations (type of tank, duration of refuelling, ambient temperature etc)

PRHYDE is a project looking into the effect of precooling in certain scenarios – it will not create any requirements for anyone in the future.

For standards, these would happen in a standardisation forum, such as ISO TC 197, or the SAE FCEV ITF – but, again, alternatives can always be accepted as long as they meet the minimum safety requirements of EN 17127 (or ISO/TS 20100)

For private stations, people can do whatever they want – any requirements would come from the operators of the station, and the vehicle suppliers.