Work Package 3: Refuelling Interfaces

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- **D:** BMW, Daimler Chrysler, Linde, Messer, Opel.
- **F:** Air Liquide, Commissariat à l´Énergie Atomique.
- **GB:** Air Products, Shell.
- **N:** Norsk Hydro ASA, Rauffoss ASA.
- **S:** Volvo.
- **E:** INTA.

INTRODUCTION

WP3 consortium will develop requirements for new draft standards of the refuelling interface "vehicle-refuelling station". This directly applies to the receptacle (vehicle based) and the nozzle (refuelling station based) and will have to take into consideration also items such as optimum storage pressure for CGH_2 storage and prerequisites of CGH_2 and LH_2 refuelling procedures. Validation of the interfaces shall ensure complies with the elaborated standard and functional operability. Standardised on-board storage pressure(s) will be vital to the safe and commercially viable introduction of CGH_2.

OBJECTIVES

- Identification of optimum on-board storage pressure levels for CGH_2.
- Development of requirements for international standardisation of interfaces (CGH_2 and LH_2)
- Approved LH_2 and CGH_2 refuelling interface/ connector.
- Investigation of refuelling procedures for CGH_2 and LH_2 dispensing, putting particular emphasis on new and innovative techniques that allow fast and economic refuelling of very high pressure and of liquid hydrogen storage tanks.

Sub-task 3.1 “Identification of optimum on-board storage pressure for CGH2”.

Sub-task 3.2 “Remaining CGH2 Activities”.

Sub-task 3.3 “Development of LH2 refuelling procedures”.

WP3 DELIVERABLES

- Proposal for an optimum CGH_2 on-board storage pressure(s).
- Definition of CGH_2 refuelling procedures.
- Approved high pressure CGH_2 connector.
- Recommendation of requirements for CGH_2 interface to standardisation committees (e.g. ISO TC197).
- Approved LH_2 connector (according to existing German and other regulations).
- Definition of LH_2 refuelling procedures.
- Recommendation of requirements for LH_2 interface to standardisation committees (e.g. ISO TC197).

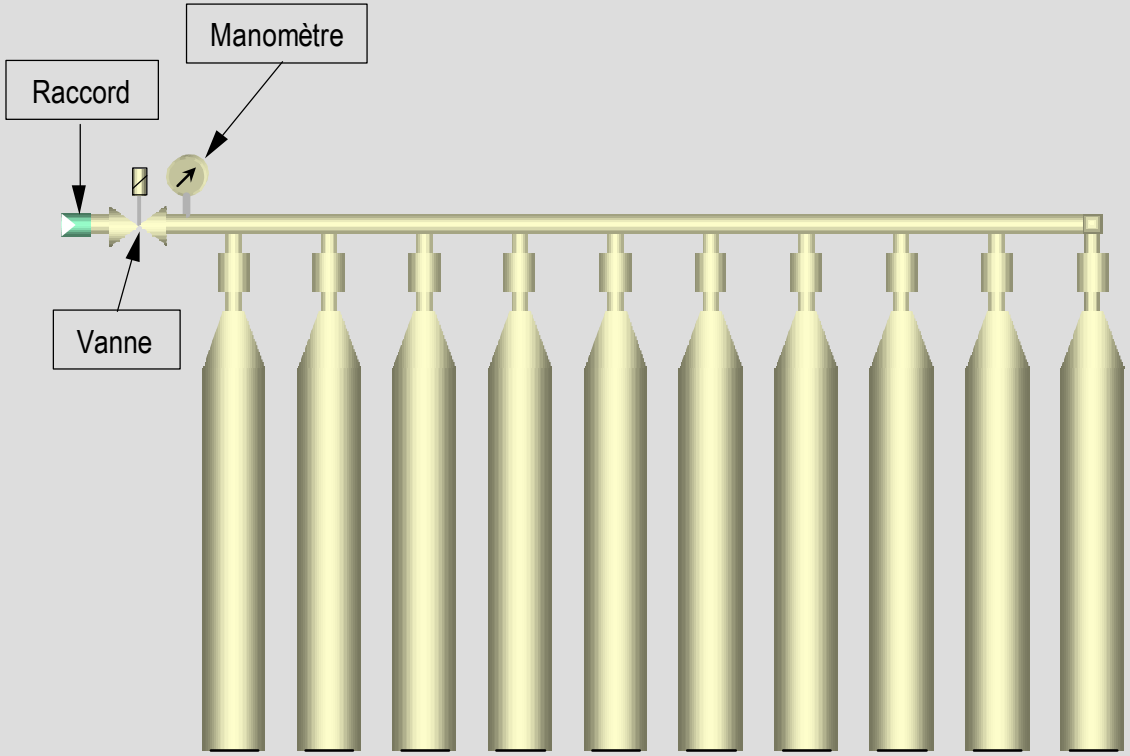
SUB-TASK 3.1 - PROGRESS OF WORK

- **Search for existing studies identifying an optimum on-board storage pressure for CGH2.**
- **Identification of issues that may cause difficulties with the introduction of very high pressure hydrogen systems (valves, fittings, temperature rise during refilling, metering systems, flexible components, material/design fatigue problems, sealing of non-metallic components, etc.). None of the issues identified were considered to be insurmountable**
- **Ongoing assessment of the optimum on-board storage pressure for city buses, with the possibility of looking at passenger cars later.**

SUB-TASK 3.2 - PROGRESS OF WORK

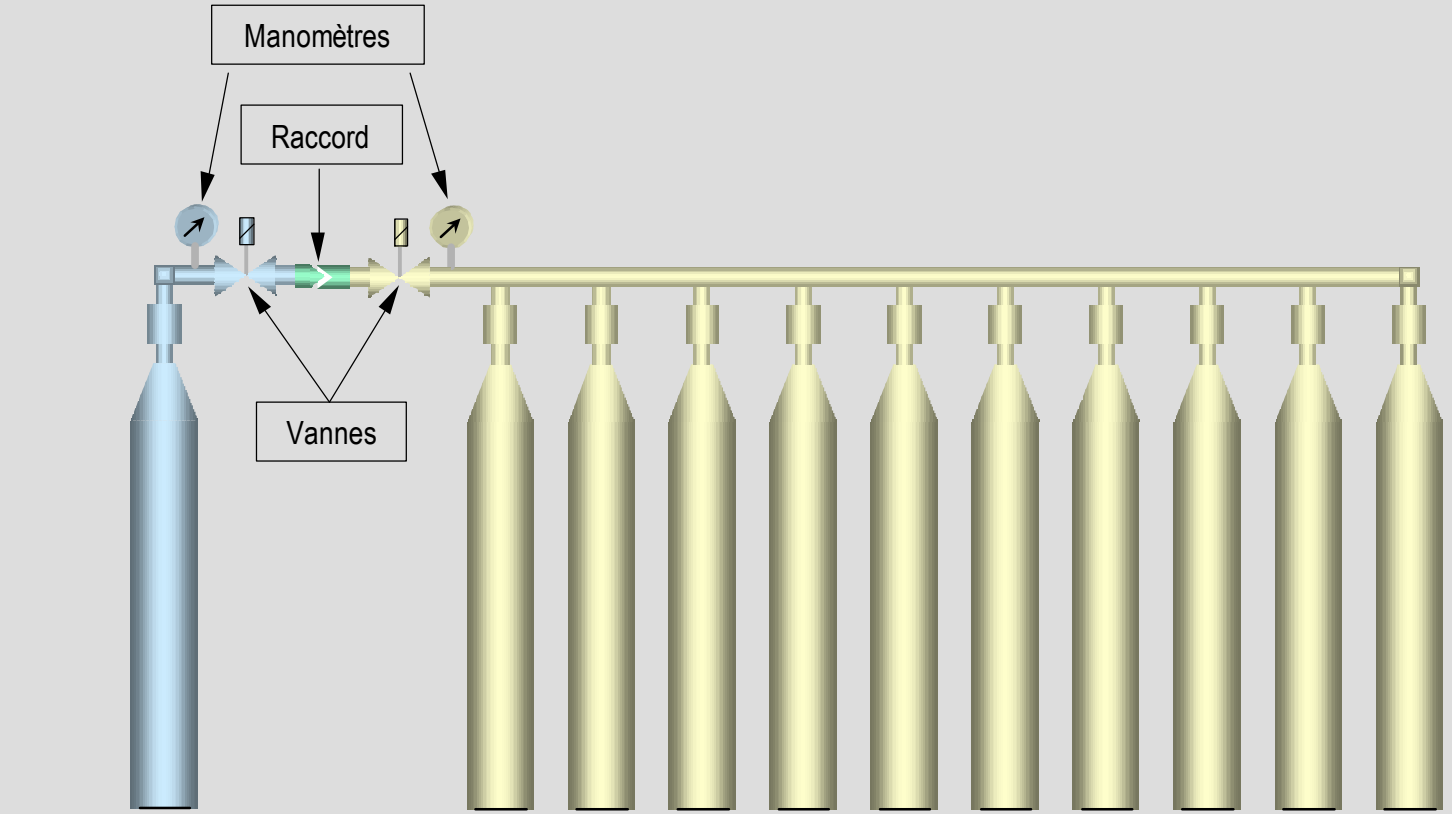
- Carried out the development of experiments of fuelling tanks in order to supply data useful to propose a refuelling procedure.
- Performed experiments: Two experiments have been performed. The objective is to simulate as well as possible a real hydrogen refuelling.
- The first experiment is a preliminary experiment consisting of the depressurising of an hydrogen reservoir at 40 MPa through the CMV08 STAUBLI connector (Figure 1).
- The second experiment is an hydrogen transfer from a tank pressurized at 440 bar to a smaller tank initially empty through the STAUBLI connector (Figure 2). Results in July 2003.

SUB-TASK 3.2 - H_2 depressurising experiment



P initiale 40MPa
P finale 10 bars
Volume 10V

SUB-TASK 3.2 - Hydrogen transfer experiment



P initiale 0 bars
P finale 350 bars
Volume V

P initiale 440 bars
Volume 10V

SUB-TASK 3.3 - PROGRESS OF WORK

- Requirements for the refuelling procedure for LH2 vehicles from the point of view of a vehicle manufacturer have been set up, discussed and updated. Possible refuelling concepts have been identified.
- Test procedures for LH2 couplings have been discussed.
- A new coupling for liquid hydrogen was manufactured and pre-tests with gaseous liquid nitrogen have been performed.
- A test stand for refuelling tests with liquid hydrogen has been constructed and further improved.
- Meanwhile most of the planned cryogenic tests with liquid hydrogen have been carried out.

Test of Clean Break Coupling with Liquid Hydrogen

- suitability of CBC for LH2
- simulation of a filling pump (subcooled liquid)
- data for different fuelling procedures
- recommendations for standardisation