HyApproval
Handbook for Approval of Hydrogen Refuelling Stations
(SES6 - 019813)

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on behalf of the
HyApproval Consortium (www.HyApproval.org)

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HyApproval Partnership

Air Liquide S.A. (AL)
Air Products PLC (APL)
BP plc
Chinese Academy of Sciences, Technical Institute of Physics and Chemistry (CAS)
Commissariat à l'Energie Atomique (CEA)
Demokritos National Center for Scientific Research (NCSRD)
Det Norske Veritas AS (DNV)
EniTecnologie S.p.A. (ET)
Engineering Advancement Association of Japan (ENAA)
Federazione delle Associazioni Scientifiche e Tecniche (FAST) in collaboration with H2IT
Forschungszentrum Karlsruhe GmbH (FZK)
GM/Opel
Health and Safety Executive (HSE)
Hydrogenics Europe N.V.
Icelandic New Energy Ltd. (INE)
Institut National de l'Environnement Industriel et des Risques (INERIS)
Instituto Nacional de Técnica Aeroespacial (INTA)
Joint Research Centre of the European Commission (JRC)
Linde AG
National Renewable Energy Laboratory (NREL)
Norsk Hydro ASA (Hydro)
Netherlands Organisation for Applied Scientific Research (TNO)
Shell Hydrogen B.V.
Total France
Ludwig-Bölkow-Systemtechnik GmbH (LBST)
Project Organigram

Project Organisation HyApproval (24 months project)

Investigated Countries
China, France, Germany, Italy, Japan, Netherlands, Spain, USA

WP0
Project Steering Group

WP1
HRS Definitions & Requirements

WP2
Handbook Compilation

WP3
Infrastructure & Deployment

WP4
Safety

WP5
Dissemination PA, CA

WP6
Vehicle Requirements

Project Working Groups

Administrative Project Management

Required Sectorial Competencies per Country Investigated:
Infrastructure • Automotive • Safety • Approval Authorities

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Main Project Goals

• finalise the hydrogen refuelling station (HRS) draft guideline document started under EIHP2 (European Integrated Hydrogen Project) and to be pursued under ISO TC197, WG 11, addressing global recommendations to the technology providers, and representing the initial basis for developing a Handbook for the approval of HRS

• come up with a Handbook which assists all gas technology companies, fuel retailers/ HRS operators and the relevant approval authorities in laying out, installing, approving and operating HRS for CGH₂ or LH₂ on an EU-wide level, with the potential to also apply it to non-EU regions

[An Approval in Principle contributes to reducing uncertainties and improving confidence for stakeholders, investors and funding bodies]
**Major Activities**

- **M0-3:** Review and evaluation
  - Establishing safety matrix
- **M3-4:** Agreement on HRS concepts, safety documentation, modelling tools & techniques, target audience
- **M5-8:** Study phase
- **M8-9:** Agreement on HRS technical and on safety documentation, approval of EIHP2 draft, complete & agree matrix table of accident simulations & scenarios, risk assessment studies
- **M9-12:** Preparation of 1st Handbook draft and carry out risk assessments & accident simulations
Major Activities (2)

• M12-15: Dissemination models for different countries and several dissemination packages completed.

• M15-21: Deployment in several Member States (MS) and support of WP3 “Infrastructure & Deployment”

• M21-23: Revision and adjustment phase for technical documentation, Handbook, EIHP2 draft, safety studies and sense check with MS and organisation of seminars in partner and non participating MS. A database of contacted agencies and officials on European and local level will be established.

• M23-24: Final partner agreement on Handbook
Main Safety Related Tasks

Safety-related tasks regarding HRS

- review and evaluate safety, codes & standards from existing projects
- establish safety matrix (RCS, safety studies, risk assessment criteria, etc.)
- establish best practices for safety
- develop realistic accident scenarios and their likelihood/ max. credible total \( H_2 \) leaks and leak rates
- agree on required modelling tools/ techniques for risk assessment and simulations
- finalisation of HRS draft guideline started by EIHP2 (⇒ WG11, ISO TC 197)
- prepare safety documentation for Handbook
Main Safety Related Tasks (2)

Safety-related tasks regarding vehicle/HRS-interface

- general data interface description for LH$_2$ and CGH$_2$, according to SAE J2601 draft, standard receptacle
- data exchange between vehicle and HRS (one standard data protocol)
- refuelling process, time, frequency, procedures, pressure levels, etc.
- definition of a safe refuelling area and process, e.g. additional grounding
- definition of best practices, usage of FMEA (Failure Mode & Effect Analysis)

→ Only a technical report so far, not yet recommended practice
Main Safety Related Tasks (3)

Pre-normative research task

– Prioritisation and detailing for scenarios/ simulations of HRS component failures:

  » CGH₂ hose break/ nozzle/ dispenser failure at 35MPa and 70MPa
  » LH₂ dispenser failure
  » CGH₂ discharge hose break from tanker at 25 MPa and LH₂ discharge hose break from tanker
     • at dedicated/ multi-fuel HRS
     • of 300kg/ 1,500kg/ 3,500kg onsite storage volume

  investigated in CFD (Computational Fluid Dynamics) simulations, if possible, in 2 independent release and dispersion calculations and 2 independent combustion calculations
Achievements in 1st Half Year (1)

WP1 – HRS Definitions & Requirements:
• ST1: Basic HRS technology *completed*
• ST2: Safety Analysis of Equipment and Distances *in progress*
• ST3: Integration of ST1 and ST2 into three “generic” HRS sizes → Draft Design Paper *established*
• ST4: RCS Review & Comparison *in progress*

WP2 – HRS Handbook Compilation:
Revised table of contents for Handbook *established*
Achievements in 1st Half Year (2)

WP3 – Infrastructure & Deployment:
• Interview protocols *defined*, questionnaires and information package *prepared*, interview phase *first interviews performed* – questionnaire continuously improved

WP4 – Safety:
• Safety matrix *established*
• Identification of accident scenarios *almost finalised*
• Agreement on safety documentation for Handbook *in progress*
• Identification and critical review of reliability data from past data collections and risk studies *in progress*
Achievements in 1st Half Year (3)

WP5 – Dissemination, Public Awareness, Intl. Cluster Activities:
• Matrix of acceptability and awareness levels of different aspects of HRS finalised
• Database of Fire Associations & First Responders established
• Calendar of relevant hydrogen events established

WP6 – Vehicle Requirements:
• General interface description for 35 MPa CGH₂ as J2600/ISO 17268 finalised [recommended practice]
• General interface description for 70 MPa CGH₂ as draft close to finalisation
• General interface description for LH₂ as draft SAE J2783 in progress
Cooperation with European Projects

HyApproval is closely interlinked to the following projects:

» HySafe
» HyFleet:CUTE and ECTOS
» ZERO REGIO
» CEP

» open to further cooperation with similar upcoming EU projects
Main Dissemination Objectives

Next steps for taking forward the technical achievements of the project

» HyApproval is the first EU project that aims at creating a universal handbook that collects the technical and regulatory requirements based on the expertise of all major companies and research institutes involved in the installation of the first HRS in Europe and abroad

» HyApproval therefore offers a unique first opportunity to disseminate its results to local authorities and inform them about the wealth of knowledge and experience already existing in Europe and the rest of the world on the use of hydrogen in transport applications and the requirements of installing the necessary elements of a hydrogen infrastructure
Useful HyApproval References

- **HySafe [03/2004 - 02/2009]** - [www.hysafe.net](http://www.hysafe.net)
- **HarmonHy [05/2005 - 04/2006]** - [www.harmonhy.com](http://www.harmonhy.com)
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