

HyApproval

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



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HyApproval Partnership

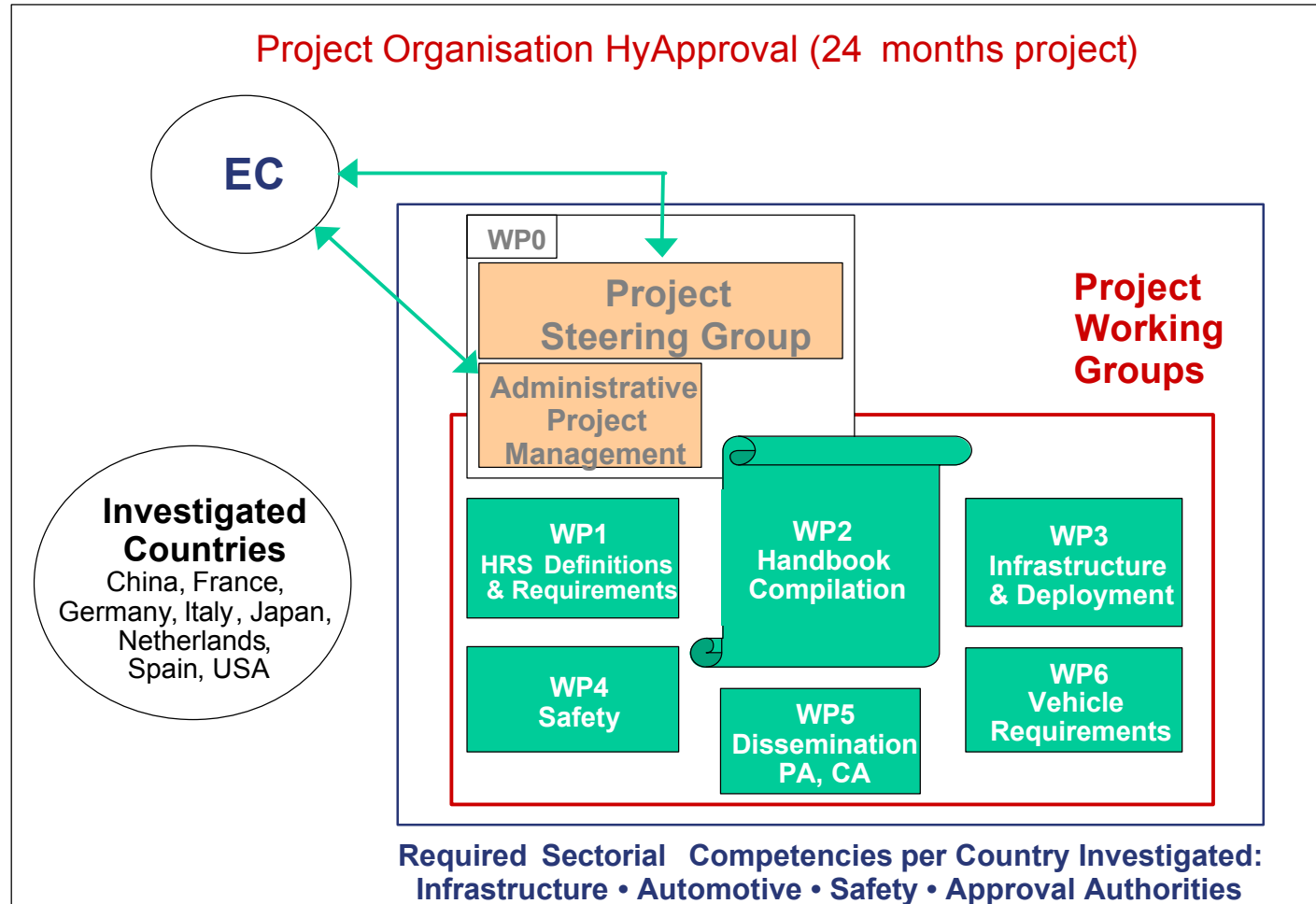
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Air Products PLC (APL)
L'Air Liquide S.A. (AL)
BP plc
Chinese Academy of Sciences, Technical Institute of Physics and Chemistry (CAS)
Commissariat à l'Energie Atomique (CEA)
Demokritos National Center for Scientific Research (NCSR-D)
Det Norske Veritas AS (DNV)
EniTecnologie S.p.A. (ET)
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GM/Opel
Federazione delle Associazioni Scientifiche e Tecniche (FAST) in collaboration with H2IT
Norsk Hydro ASA (Hydro)
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
Hydrogenics Europe N.V.
Shell Hydrogen B.V.
Netherlands Organisation for Applied Scientific Research (TNO)
Total France
National Renewable Energy Laboratory (NREL)
Health and Safety Executive (HSE)
Engineering Advancement Association of Japan (ENAA)
L-B-Systemtechnik GmbH (LBST)



Project Organigram



Main Project Goals

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- 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]



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 H₂ 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)

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Safety-related tasks regarding vehicle/HRS-interface

- general interface description for LH₂ and CGH₂, 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
- define best practices, use FMEA (Failure Mode & Effect Analysis)



Main Safety Related Tasks (3)

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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, of 2 independent release and dispersion calculations and 2 independent combustion calculations



Major Activities

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- 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)

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- 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



Preliminary Table of Contents of Handbook (1) **HyApproval**

- 1.0 Introduction
- 2.0 Basics of hydrogen dispensing
- 3.0 Hydrogen refuelling station best practises
 - 3.1 Construction Requirements for Gaseous Hydrogen Storage
 - 3.1.1 Site Selection and System Sitting
 - 3.1.2 Storage System
 - 3.1.3 Dispensing System
 - 3.2 Construction Requirements for Liquefied Hydrogen Storage
 - 3.2.1 Site selection & system sitting
 - 3.2.2 Storage system
 - 3.2.2.1 Under-ground storage systems
 - 3.2.2.2 Above-ground storage systems
 - 3.2.3 Dispensing system
 - 3.3 Operating Requirements for a hydrogen refuelling station facility
 - 3.4 Maintenance requirements for a hydrogen refuelling station facility
 - 3.4.1 Gaseous Hydrogen station
 - 3.4.2 Liquefied Hydrogen station



Preliminary Table of Contents of Handbook (2) **HyApproval**

4.0 Definition of the minimum requirements concerning hydrogen refuelling station lay out

- 4.1 Industrial (or non-public access)
- 4.2 Retailing (or public access)

5.0 Vehicle requirements

- 5.1 General requirements
- 5.2 Grounding
- 5.3 Instrumentation of the tank system
 - 5.3.1 Gaseous Hydrogen tank
 - 5.3.2 liquid Hydrogen tank
- 5.4 Communication with the vehicle
 - 5.4.1 Gaseous Hydrogen tank system
 - 5.4.2 Liquid Hydrogen tank system
- 5.5 Refuelling interface
 - 5.5.1 Gaseous Hydrogen for 35 MPa systems
 - 5.5.2 Gaseous Hydrogen for 70 MPa systems
 - 5.5.3 Liquid Hydrogen systems
- 5.6 Driver training
- 5.7 Others



Preliminary Table of Contents of Handbook (3) HyApproval

- 6.0 Codes and Standards Affecting Design, Installation, Operation & Maintenance of a hydrogen refuelling station
 - 6.1 Hydrogen production
 - 6.2 Hydrogen storage
 - 6.3 Dispensing Facility
 - 6.4 Overview
 - 6.5 Codes and Standards Tables
- 7.0 Case Study : Uniformly accepted (virtual) refuelling station design and lay out
 - 7.1 Project Description
 - 7.2 Installation Type
 - 7.2.1 Hydrogen Storage System
 - 7.2.2 Hydrogen Transfer System
 - 7.2.3 Installation Operation & Maintenance
 - 7.3 Safety (or Isolation) distances & hazardous areas
 - 7.4 Codes and Standards
 - 7.5 Additional Resources



Preliminary Table of Contents of Handbook (4) **HyApproval**

8.0 Country specific issues

8.1-8.6 France, Italy, Germany, The Netherlands, Spain, China

8.x.1 Responsible bodies

8.x.2 Information flow chart

8.x.3 Authorities feedback

9.0 Available safety cases

Cooperation with European Projects

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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



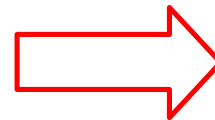
Next steps for taking forward the technical achievements of the project

- » HyApproval is the first EU project that looks 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 the results of this EU joint effort 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

HyApproval

- HyApproval [10/2005 - 09/2007] - www.hyapproval.org;
- HySafe [03/2004 - 02/2009] - www.hysafe.net;
- HarmonHy [05/2005 - 04/2006] - www.harmonhy.com;
- European Integrated Hydrogen Project [1998-2000, 2001-2004] - www.eihp.org;
- EU projects on H₂/FC - http://europa.eu.int/comm/research/energy/pdf/h2fuell_cell_en.pdf;



Acknowledgement

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