Integrated design for demonstration of efficient liquefaction of hydrogen (IDEALHY)

Fuel Cells and Hydrogen Joint Undertaking (FCH JU)

Grant Agreement Number 278177

Title:	HAZIDs for Hydrogen Liquefaction, Storage and Transportation *(Publishable Summary)*
Authors / Project Partner:	G. Hankinson and B. J. Lowesmith / Loughborough University
	S. Chynoweth / Shell
Work Package:	Technology Analysis and Conceptual Liquefaction Process Assessment
Deliverable Number:	3.10
Date:	10 July 2013
Report Classification:	Restricted (here: *Publishable Summary*)

New Energy World JU
fuel cells & hydrogen for sustainability

Approvals	
WP Leader	✓
Coordinator	✓
FCH JU	**pending**

Contacts
G.Hankinson@lboro.ac.uk@tu-dresden.de **info@idealhy.eu**

Acknowledgements

The research leading to these results has received funding from the European Union's Seventh Framework Program (FP7/2007–2013) for the Fuel Cells and Hydrogen Joint Technology Initiative, under grant agreement number 278177.

Disclaimer

Publishable summary

Hydrogen is seen as an important energy carrier for the future which offers carbon free emissions at the point of use. In particular, hydrogen could be used to power vehicles using hydrogen fuel cell technology and thereby replace the use of petrol and diesel. In the absence of a hydrogen pipeline supply network, which would be costly and take considerable time to build, hydrogen could be supplied using road tankers. However, transporting hydrogen by road as a compressed gas is very inefficient and supplying liquefied hydrogen (LH2) by road tanker is seen as the most effective way forward in the medium term. This will require large quantities of LH2 to be produced, stored and transported for re-fuelling vehicles.

The IDEALHY project receives funding from the European Commission's 7th framework programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Technology Initiative. The project has the aim of developing a new hydrogen liquefaction process which will enable LH2 production to be undertaken at increased scale (50-200 tpd) and with significantly increased efficiency. The production of large quantities of LH2 and the subsequent road transportation and storage at vehicle re-fuelling stations (often in urban areas) present new challenges in terms of ensuring the safety of the public. For these reasons, as part of the IDEALHY project, the safety of the proposed production and supply system is to be considered.

This report presents the results of two HAZard IDentification (HAZID) exercises, one on the transport by road tanker and storage of liquid hydrogen at re-fuelling stations, and the other on the liquefaction of hydrogen and storage of the liquid hydrogen at the production site. The HAZIDs were carried out by the partners of the IDEALHY project. The purpose of the HAZIDs was to identify untoward events that could occur as a result of handling the hazardous materials involved in the proposed new hydrogen liquefaction process developed as the main objective of the IDEALHY project. In addition a review of related incidents involving liquid hydrogen was performed.

Following completion of the HAZIDS and the incident review, analysis of their results was undertaken. The purpose of this analysis was to identify the causes and consequences of the incidents to provide information that can eventually be used to assess the risk of such operations.

Analysis of the causes of incidents showed that design or construction failure, equipment failure or procedural deficiency dominated the causes of both the reviewed incidents and the untoward events identified through the HAZIDs. These three causes involve the greatest amount of human involvement which may account for the higher proportion of incidents/untoward events compared with the other causes

Analysis of the consequences of incidents showed that the majority result in a release of either gaseous or liquid hydrogen. About half of these releases are ignited and of these fires and explosions occur in about equal proportions. Sometimes both a fire and an explosion occur during the same incident. In one incident both a fire and a BLEVE occurred.

Key words

Liquid hydrogen, HAZID, accumulation, dispersion, fire, explosion, BLEVE

Abbreviations

BLEVE	Boiling Liquid Expanding Vapour Explosion
HAZID	Hazard Identification
LH2	Liquefied Hydrogen
LOC	Loss of containment
MR	Mixed refrigerant
RPT	Rapid phase transition
RTA	Road traffic accident
tpd	tonnes per day

Table of Contents