REQUIREMENTS FOR THE SAFETY ASSESSMENT FOR THE APPROVAL OF A HYDROGEN REFUELING STATION

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ABSTRACT

The EC 6th framework research project HyApproval will draft a Handbook which will describe all relevant issues to get approval to construct and operate a Hydrogen Refuelling Station (HRS) for hydrogen vehicles. In WP3 of the HyApproval project it is under investigation which safety information competent authorities require to give a licence to construct an operate an HRS. The paper describes the applied methodology to collect the information from the authorities in 5 EC countries and the USA. The results of the interviews and recommendations for the information to include in the Handbook are presented.

1.0 THE HYAPPROVAL PROJECT

It is expected that hydrogen will play a significant role as a motor fuel in future. To become successful as a fuel for use in the transportation sector an infrastructure, with a network of hydrogen refuelling stations (HRS), will need to be developed. A widespread HRS network will require that layout, installation, approval and operation of HRSs are harmonised. This includes the development of harmonised compatible regulations, standards (e.g. minimum safety distances) and dimensions (e.g. the same couplings for dispensing the same type of fuel). Within the European Union's 6th Framework Programme the HyApproval project was defined, intended to be a 24 month project, aimed at developing a Handbook to facilitate the approval of hydrogen refuelling stations for road vehicles.

The Handbook shall provide guidelines for facilitating the approval process and allowing (at an early stage) an "Approval in Principle" from relevant authorities and the identification of specific local issues that should be addressed. Consequently the document will be a best practice on how to help achieving approval at an early stage. The document will reflect the existing technical and regulatory environment, will be flexible and will allow updates as the market conditions change. These best practices are a.o. derived from existing experience and case studies gained through projects such as Clean Urban Transport for Europe (CUTE), Ecological City Transport System (ECTOS), European Integrated Hydrogen Project (EIHP), Clean Energy Partnership Berlin (CEP), Lombardia and Rhein-Main towards Zero Emission: Development and Demonstration of Infrastructure Systems for Hydrogen as an Alternative Motor Fuel (ZERO REGIO) and Safety of Hydrogen as an Energy Carrier (HySafe) as well as other consortium partner initiatives.

The project contains a number of work packages. WP1 is the description of the design and technical systems of an HRS. WP2 is the development of the Handbook. The objective of work package 3 (WP3) is to identify the requirements of the authorities with respect to the *safety assessment* for the approval of an HRS in 5 EU member states (France, Germany, Italy, Spain and the Netherlands) and the USA. In WP4 Research Institutes in France (Ineris), Germany (FZK), Greece (NCSR Democritos), Italy (ENI S.p.A) and The Netherlands (JRC Petten) investigate with CFD modelling techniques the dispersion and combustion of accidental releases of Hydrogen at an HRS. WP4 also includes a quantitative risk assessment of an HRS. WP5 takes care of the dissimination of the HyApproval results to the authorities and fire brigades. WP6 investigates the vehicle requirements for an HRS.

2.0 APPLIED METHODOLOGY

2.1 Introduction

In general local authorities have no experience with the approval of an HRS. In the CUTE project it was very difficult in some cities to get an approved HRS. Therefore it does not make sense to ask the local authorities how they would approve an HRS. For that reason it was decided to broaden the scope of the approval process for fixed installations with hazardous materials. A lot of authorities have already experience with the application of the EC Post Seveso Directive on the Prevention of Major Hazards (96/501/EC) or country specific regulations to manage the risks of activities with flammable or toxic materials.

The following activities were performed to get a good insight in the approval process:

1) Identify stakeholders to be interviewed
2) Prepare an interview protocol
3) Perform interviews
4) Report findings
5) Prepare a draft for harmonised safety assessment

2.2 Identification of stakeholders

The WP3 partners Air Liquide (France), ENI S.p.A. (Italy), Hydrogenics (Germany), INTA (Spain), NREL (USA) ,TNO (Netherlands) identified the following categories of stakeholders in the HRS approval process:

- *The owner of the HRS* who will generally be the applicant for the permit(s).
- *The authority or authorities issuing the permit(s).* Depending on the political organisation in the various countries, the competent authority to issue the permits could be an autonomous region, a local regulator, or even an accredited supervisory board. Often separate permits are required for building and operation of an HRS.
- *Advisors to the* authorities issuing the permit(s). The authority may seek specialised advise for the issues to be considered like environmental impact, public health and safety and workers health and safety. The following was suggested:
  - *Fire brigade.* In most countries the fire brigade gives (compulsory) advise on permits on (preventive and mitigating) safety measures and on contingency planning.
  - *Labour inspectorate and /or other inspectors.*
- *The (governmental and/or advisory) bodies responsible for creation and / or implementation of guidelines and legislation* as applied by the authorities issuing the permit(s).
- *Members of the public working and/or living in the vicinity of the (future) HRS*

In those EU countries where HRSs had been established in the framework of the CUTE (Clean Urban Transport for Europe) project (Germany, Spain, The Netherlands) the authorities involved in the approval process, were approached. In Italy and the USA authorities involved in the approval process of HRSs, built outside the CUTE context, were approached. As no HRS existed in France it was decided to approach the authorities involved in the regulations on dangerous substances (like SEVESO II) as a starting point. In

Table **¡Error! No hay texto con el estilo especificado en el documento.**-1 an overview of the organisations interviewed is given.

Table **¡Error! No hay texto con el estilo especificado en el documento.**-1. Overview of parties interviewed in various countries

Country	Approval role	Name of organisation interviewed
Germany	Issuer of permit	Behörde für Soziales, Familie, Gesundheit und Verbraucherschutz - Hamburg
	Advisor to issuer	Gewerbeaufsichtsamt bei der Reg. v. Oberbayern - München
	Inspection authority	Regierungspräsidium Darmstadt, Abt. Arbeitsschutz. Frankfurt.
France	Advisor to issuer	Firebrigade Fontaines, Isère
		Ministère de l'Intérieur, Direction de la Défense et de la Sécurité Civile DDSC - Risk and Crisis Management – in charge of technical and chemical hazards.
	Responsible for legislation	Ministère de L'écologie et du développement Durable - coordination of inspection services (DRIRE).
	none	Coordination of Hydrogen project founding in Direction Générale des Entreprises within MENEFI.
Italy	Issuer of permit	Single Counter for Business Activities of Mantova City Council
	Advisor to issuer	Local Health Service of the Province of Mantova, Service for Prevention and Safety in the Working Environment
	Advisor to SIUC for building permit and operating licence, issuer of Fire Prevention Certificate	Comando Provinciale Vigili del Fuoco (Provincial Fire Brigades Headquarters)
	Hierarchically superior to Provincial Fire Brigade Headquarters	Ispettorato Regionale dei Vigili del Fuoco della Lombardia (Lombardy Region's Fire Brigades Headquarters)
	Advisor to issurer	Lombardy's Regional Environmental Protection Agency, Department of Mantova, Operative Unit: Territory and Integrated Activities
	Inspection authority	ISPESL (technical-scientific body in the National Health Service)
Netherlands	owner	GVB – Municipal Transportation Company Amsterdam
	Issuer of permit	Amsterdam City council
	Advisor to issuer	Environmental & Building Department (DMB-Amsterdam)
		Fire brigade Amsterdam
	Responsible for legislation	Inspectorate of the Ministry of Housing, Spatial Planning and the Environment
	None	NIFV Netherlands Institute Physical Safety Nibra Arnhem (Task a.o: Training institute for fire brigade)
Spain (Madrid)	Owner	Empresa Municipal de Transporte (EMT) - Madrid
	Issuer of permit	Comunidad de Madrid. Dpt. De Industria. Madrid
Spain (Barcelona)	Customer	TMB (Transportes Metropolitanos de Barcelona)
	Issuer of permit	Generalitat de Cataluña. Dpt. De Trabajo e Industria. Secretaría de Industria. Barcelona
USA	Advisor to issuer District of Columbia	DC Office of the Fire Marshal
		DC Department of Health: Environmental Division
		DC Department of Consumer and Regulatory Affairs
	Advisor to issuer State of Michigan	Michigan Department of Environmental Quality/Waste and Hazardous Materials Division/StorageTank Unit
	Advisor to issuer State of California	Office of the State Fire Marshall

	Issuer of permit State of New York	New York State Dept. Division of Code Enforcement and Administration
	Issuer of permit State of Nevada	Local government of Las Vegas
	Advisor to issuer State of Florida	Department of Environmental Protection, Tallahassee, Florida
		Division of State Fire Marshal Tallahassee
	Issuer of permit State of North Carolina	Office of the State Fire Marshall in the Authority Having Jurisdiction (AHJ)

'Members of the public' were also identified as stakeholders in the approval process. There response will be derived from there participation in the discussion around the CEP HRS in Berlin and the Berning Road HRS in Washington DC.

2.3 Interview protocol

In order to identify the requirements of the authorities regarding the safety assessment of the approval of HRS, an interview protocol was prepared. The following topics were covered in the interviews:

A. The responsibility and liability of the stakeholder involved in the approval process
B. The required information by the authorities
C. The external and occupational safety policy concerning hydrogen
D. The assessment criteria for the technical systems of the HRS (Technical standards)
E. Availability of methodologies and guidelines for the assessment of external (off-site) effects, damage and risks
F. External safety (off-site safety) and land use planning
G. Inspection
H. Emergency planning
I. Dissemination of the Hy-Approval handbook
J. Remarks / other issues / gaps

In those cases where a particular HRS was discussed technical information on this station was obtained. Depending on the interviewed party, certain topics gained more attention than others.

3.0 SAFETY REQUIREMENTS OF THE APPROVING AUTHORITIES

In this chapters the most important results of the interviews are summarized.

Early coordination and communication

Early coordination and communication was emphasised as an important prerequisite to get acceptance of the HRS. It should be clear which authority has the coordination role. It is advisable that the parties involved seek agreement on discrepancies in an early stage. To facilitate community acceptance of the HRS it is advisable to determine the requirements for community relations efforts. Neglect of the community concerns and issues may delay the implementation of the project afterwards.

Aplicable Laws and Regulations

The information that is required for the approval of the building and operation of an HRS will depend on the laws and regulations applicable. As HRSs are a relatively new phenomenon there is not yet a complete view of the risks involved. Neither do dedicated regulations or guidelines exist. Hence other sources of information were used. In some countries the national implementation of the SEVESO-II guideline is the leading document. As quantities of hydrogen currently stored, or planned to be stored, at an HRS (max. 3.5 tons) are well below the lower limit specified in the SEVESO guidelines (5 tons) these guidelines are, strictly speaking, not applicable. They were mainly used as an information source for methods, techniques and criteria that could be useful for the safety assessment of an HRS. Once the safety risks associated with an HRS are understood, a more general approach (as for e.g. LPG

stations in the Netherlands) may be adopted. It was indicated by the interviewees that a the Hy-Approval handbook could be an aid in this process.

Required permits and information

The approval process of an HRS generally includes the following permits:

- A building permit,
- An environmental permit and
- An operating permit.

Not all permits are required in each country and the order in which permits have to be obtained differs as well. In most countries the following documents have to be submitted to the authorities with the request for the permits:

- Location of the HRS and its surroundings (drawing and lay-out)
- List of plant components e.g. piping, fittings, vessels, materials, heat exchangers etc. and used guidelines/regulations.
- A short description of the process and Process Flow Diagrams (PFD's)
- Impact study on environmental impact in day to day use (gaseous and liquid emissions, noise emissions, waste water, soil contamination)
- Mitigating and preventive safety measures including explosion and fire detection
- Intervention measures in the event of abnormalities

In addition some countries/states require:

- Hazard identification study, special attention for brittleness (For information on brittleness see EIGA Doc 15 05)
- Qualitative or Quantitative Safety Assessment
- Declaration of installation of pressurized equipment
- Electrical design as well as grounding system and lighting protection system
- Listing of measuring and control systems
- Listing of applicable Regulations, Codes & Standards
- Installation plan and utilities
- Operating instructions

Safety assessment

This report is focussed on the requirements of the authorities regarding the *safety assessment* of the approval (being the objective of WP3). Three target groups are distinguished by the interviewees for the safety assessment:

- Employees of the service station – This is workers safety. This is often the concern of the Labour inspectorate. This aspect was not specifically addressed during the approval process, except in Germany. However, the HRS operating permit itself often contains regulations concerning the skills of attendants and the procedures to be followed by them (e.g. in case of an emergency). Also it is implicitly assumed that compliance with technical standards will largely take care of workers safety. This applies for the Netherlands, Spain and Italy.
- Safety of customers at the filling station. For professionals, like the bus drivers of hydrogen fuelled busses, the HRS permit may require that persons that execute the refuelling operation

should be well instructed. For private customers safety should be more or less guaranteed by proper technical standards.

– The general public, outside the HRS. This is the target group for *external* safety. The basic principle of external safety is to guarantee the general public a specific level of protection against threats posed by dangerous substances in their immediate environment..

In all countries three stages are distinguished in the applied policy to manage the risk for the three target groups:

1. Prevention of accidents by application of state of the art technology and following technical standards
2. Creation of a safety zone or safety distance.
3. Optimal preparation of emergency services (contingency planning).

Accident prevention

Prevention of accidents (and thus taking care of external, worker's and customer's safety) is realised by applying state-of-the-art technology through standards and guidelines. These guidelines are mostly based on experience with compressed natural gas (CNG) but may also be formulated in general terms (like the BetriebsSicherheitsVerordnung Betr.SV – Germany). Table ¡Error! **No hay texto con el estilo especificado en el documento.**-2 and Table 3-3 show the applied technical regulations for the construction of an HRS used in European countries and in the USA. In Table ¡Error! **No hay texto con el estilo especificado en el documento.**-3 Technical standards and regulations taken into consideration for approval of HRS's in various European countries are shown.

Table **¡Error! No hay texto con el estilo especificado en el documento.**-2.Technical standards used in all European countries

Pressure Equipment Directive 97/23/EC
Machinery Directive 89/392/EC, 98/37/EC
Low voltage Directive 2006/95/EC
Electro Magnetic Compatibility Guideline 89/336/EC
ATEX Directive 94/9/EC: Guidelines for determination "non-classified", "zone 0", "zone 1", zone2 in IEC 60079-10. Explosion safe equipment according EX-Zone 1 at locations where H2 is present in apparatus and pipelines

Table **¡Error! No hay texto con el estilo especificado en el documento.**-3. Considered regulations for approval of HRSs

France	No information
Germany	Technical regulations in BetrSV (leading document) DM 31/8/2006 (leading document) Non binding references: NFPA 50A (now NFPA 55) - EIGA 15/96
Italy	ISO 15916:2004 provides guidelines for the use of hydrogen in its gaseous and liquid forms. It identifies the basic safety concerns and risks, and describes the properties of hydrogen that are relevant to safety. Detailed safety requirements associated with specific hydrogen applications are treated in separate International Standards
Spain	Regulation of Pressure apparatus Real Decreto 2486/1994 (CNG regulation)
Netherlands	PGS 25 (CNG) NFPA 50 (now NFPA 55) NFPA 52 2006 (LNG)
Various countries	Regulations for the storage of hazardous substances.

Table **¡Error! No hay texto con el estilo especificado en el documento.**-4. Technical standards used in the USA

NFPA 55
NFPA 30A
NFPA 57
NFPA 59A 2006
NFPA 70
ASME BPV Code Section VIII, Div.I and Section IX

Safety zones

In addition to the prescriptive safety policy, risks may further be reduced by spatial zoning, i.e. the application of safety distances. France and the Netherlands use a Quantitative Risk Assessment (QRA) to determine the safety distance. In Italy specific safety distances for HRS included in DM 31/8/2006 are used (based on previous experience with CNG). A QRA, performed on the first HRS in Italy, had shown these to be adequate. In the US safety distances are determined on the basis of state regulations and applicable codes. In Spain, both HRS's are inside the bus station perimeters so they do not consider special distance requirements. The HRS's are not considered to be "public" ones. Germany mentions the use of safety distance, but no method is specified. Table ¡Error! **No hay texto con el estilo especificado en el documento.**-5 presents the methods used to assess external safety.

Table **¡Error! No hay texto con el estilo especificado en el documento.**-5. Methodologies and Guidelines for the assessment of external (off-site) effects, damage and risks

France	The evaluation of the risk is the responsibility of the owner and must be done with both quantitative and qualitative methods with a risk based approach but without commonly accepted methods or software.
Germany	Limited to a hazard evaluation according to BetrSV and Explosion protection
Italy	Because of the small amounts of dangerous substances involved, an external safety study is not legally required for an HRS, as for other low-to-medium risk activities. A QRA for each station is not required. However, being the first public HRS in Italy, a quantitative risk analysis as prescribed by the "High Risk Activities" Seveso Directive was also considered in the approval procedure for the Zero Regio's HRS in Mantova.
Spain	No QRA will need to be done for each station. No specific guidelines exist. The existing normative for compressed natural gas is used, taking into account the special characteristics of H2.
Netherlands	In NL a QRA will need to be done for each station. No specific guidelines exist for HRSs and *until specific requirements for H2 are specified (as with LPG) this will be the case*. The Dutch guidelines (as defined for Seveso establishments in CPR-18) will be leading, i.e. scenarios and failure frequencies, will be derived from this to determine safety distances. Relevant distances are also used for land-use planning purposes, e.g. if risk criteria are not met, relocation will be necessary.
USA	In general, states or local governments do not perform quantitative risk assessments nor do they require them of project developers. However, in the United States, it is very common for project developers themselves to perform quantitative and/or qualitative risk assessments and/or FMEAs

From the information in Table ¡Error! **No hay texto con el estilo especificado en el documento.**-5 it can be concluded that for Netherlands, Italy, France, where external safety was/is an identified important issue, QRAs, along the lines of the local interpretations of the SEVESO II guidelines, have been or should be performed, resulting in an assessment of off-site effects, damage and risks. In the other countries no specific methods for external safety were mentioned. Nonetheless, for all countries

documents are required in which the safety measures are outlined. In Spain, USA (where external safety was also considered important) and also the Netherlands the choice of the most suitable method is left to the expert judgement of operator, constructor and / or owner of the HRS.

Although all countries, apart from Spain, mention the use of safety distances it is not always clear how (or if) they are used in relation to land-use planning. Only for the countries in which these distances are based on methods derived form the SEVESO directive (Italy, Netherlands France) a link seems to be present (see Table ¡Error! **No hay texto con el estilo especificado en el documento.**-6).

Table **¡Error! No hay texto con el estilo especificado en el documento.**-6. External safety and land-use planning

France	Safety distances inside and outside the HRS are applied according IPCE[1] law when more than 50 tons H_2 .
Germany	Safety distances inside and outside the HRS are applied.
Italy	The location of the HRS must be compliant with the City Council's general plan and zoning ordinance for ordinary refuelling stations and preferably CNG refuelling stations. In case the HRS is located in an area comprising an high-risk activity, local authorities at the higher level than the City Council, i.e., the Province and/or the Region has to compile a risk analysis report of the whole area by putting together the information provided by each single activity in the area. This document must take into consideration also any planned future business or building activity in the area. There is no specific provision for HRS.
Spain	Both of the HRS were considered as temporarily ones and operating into already restricted areas (bus stations). Outside safety distances are applied according the City Council's general plan.
Netherlands	A municipality may only designate a piece of land for a high-risk activity in an establishment if the associated risks to the vicinity do not exceed the limit values laid down in the External Safety Establishments Decree. The Decree established environmental quality standards in the form of limit values for location-based risk, e.g. 10^{-6} per annum for vulnerable objects and for sites in the process of remediation.
USA	No information obtained

Contingency planning

In all countries contingency planning is included in the safety policy. Usually the fire brigade is the leading party in here. Emergency response organisations like the fire brigade, ambulance services and the police should be prepared for accidents that might occur. In most countries the leading party regarding contingency planning is the fire brigade. Many of the interviewed parties indicated that they would like to see the intervention measures for the various incident scenarios at HRSs explicitly stated in the HyApproval Handbook.

Inspection protocol

Only France reported to have a special inspection protocol for HRSs, the other countries mentioned general inspection protocols. As can be seen in Table ¡Error! **No hay texto con el estilo especificado en el documento.**-7 these protocols are usually based on maintenance/inspection demands of the equipment used (as prescribed by the owner and / or manufacturer). In addition to this these protocols

[1] ICPE: Installation Classée pour la Protection de l'Environnement

involve the participation of the fire brigade and can be based on risk level. In Spain an inspection protocol, based on the risk, is currently being developed.

Table **¡Error! No hay texto con el estilo especificado en el documento.**-7. Inspection protocols used in various countries

France	Inspection of ICPE in France is clearly organized and not delegated to private notified bodies (except for pressure vessels). The protocol for inspection is available (in french) at the following address : http://www.drire.gouv.fr/environnement/controle.html It is under the responsibility of the DRIRE under the sole authority of the Préfet. In France, 850 inspectors are in charge of 63200 installations subject to authorization. In case of request from the préfet combined inspections by veterinary (in case of refuelling station in a supermarket when food is sold), DRIRE, and fire brigades can be done.
Germany	According BetrSichV every 5-years by Competent Safety Organisation. Tubes every half year by operators + manufacturers regulations. Also: 24 months after start-up and every three years.
Italy	No specific protocol exists. General procedure for conventional or, better, CNG refuelling station will apply. Only the first inspection during the plant start-up will be carried out by all inspecting bodies simultaneously. In Italy the responsible authority for workers safety (ASL) is present at the start-up inspection and may carry out further inspections during operation. The fire brigades will make an inspection every three year.
Spain	No specific protocol exists. Fire brigade applies general checklist. Owner does visual checks but without high regularity. Supplier of equipment does 6 monthly check or, at least, the time suggested for the devices manufacturer. This, however, is primarily because of the novelty and the experimental character of the Madrid and Barcelona HRS. Technical reliability of the HRS is determined by equipment supplier. Owner is alerted when replacements are due.
Netherlands	No specific protocol exists. Fire brigade applies general checklist. Owner does regular (once a week or so) visual checks. Supplier of equipment does a weekly check. This, however, is primarily because of the novelty and the experimental character of the Amsterdam HRS. Also VROM will apply 'general' inspection techniques. Technical reliability of the HRS is determined by equipment supplier, and monitored by the software. Owner is alerted when replacements are due. There is an increasing tendency in the Netherlands to have private notified bodies perform the obliged controls of the installation. However, such a notified body for HRS's does not exist yet.
USA	The states are not involved in conducting periodic (i.e., annual or unannounced) inspections of hydrogen fuelling stations. Uniformly, this is the responsibility of the local fire marshal and/or fire department. Local fire protection authorities, in general, have the authority to cite project operators for violations of safety regulations or shut down a facility if they believe that there is an imminent fire safety hazard. In nearly all projects, the operators and/or vendors have documented, systematic inspection protocols.

Dissemination of the Handbook

Table ¡Error! **No hay texto con el estilo especificado en el documento.**-8 presents the response of the interviewees on the subject dissemination of the Handbook. As can be expected from the response the use of the Handbook will depend on the relevance of the information in the book to the problems that the various stakeholders are confronted with. Of course this will become much clearer after the first draft of the Handbook has been presented to them.

A point to be noted is that the (legal) status of the Handbook will also affect its use.

Table **¡Error! No hay texto con el estilo especificado en el documento.**-8. Dissemination of the Handbook

France	Organisations would use the Handbook if it would contain relevant information to particular problems. Dissemination through DDSC[2]
Germany	Some interviewees answered that the Handbook will not be used because it has no legal status
Italy	Organisations would use the Handbook if it would contain information related to their field of responsibility. Formal recognition of the Handbook by Italian authorities would greatly help its dissemination and acceptance.
Spain	Organisations would use the Handbook if it would contain relevant information to problems such as: 1. What functions and buildings are allowed near HRS's? 2. Technical Standards 3. Intervention measures
Netherlands	Organisations would use the Handbook if it would contain relevant information to problems such as: 1. What functions and buildings are allowed near HRS's? 2. Technical Standards 3. Intervention measures
USA	No information

4.0 CONCLUSIONS AND RECOMMENDATIONS

In all interviewed countries three stages of safety assurance are distinguished in the approval process of an HRS:

1. Prevention of accidents by application of state of the art technology and following technical standards
2. Creation of a safety zone or safety distance.
3. Optimal preparation of emergency services (contingency planning).

Prevention of accidents

There was good agreement on the first of these stages between all 5 EU countries They all used the same technical standards (EU regulations) sometimes augmented with local regulations. Also some American standards (most notably NFPA-standards) are used sometimes. The USA have their own technical standards and legal requirements, although many are similar to EU regulations.

It is recommended to include in the Handbook a detailed technical description of the HRS and the applied regulations and technical standards.

Safety distances

Although all countries do mention the use of safety zones it is not always clear how they are derived and which criteria acceptability levels are used. Very clear are the Dutch standards for external safety, which are also used for land-use planning. Vulnerable buildings (dwellings, offices, hospitals etc.) are not allowed in areas with a Location Specific Risk above 10-6 per year. Also in France risk based criteria for external Safety have recently been defined. In addition to fatalities (as in the Netherlands) injuries to persons are used as a criterion. Acceptability levels are not clearly defined. Italy assessed the consequences according to damage limits provided for in DM 9/5/2001. No acceptance levels are stated by laws. Acceptance levels have to be negotiated and agreed upon by interested parties and authorities having jurisdiction. Based on pilot studies on a few early HRSs it has already been decided that safety distance as applied for CNG can be used, which means no further QRAs are required for new HRSs. In the USA safety distances or separation distances for hydrogen facilities are provided in the International Code Council (ICC), International Fire Code (IFC), NFPA 52 and NFPA 55.

[2] DDSC: Département Defense et Securité Civile.

Spain has not adopted specific safety distances that are related to the possible risks of the HRS. Due to the situation of the HRS (inside bus station perimeter, not open to the public) the safety distances are the same as used for the bus station itself (City Council's general plan). Germany report the use of safety distances. It is however unclear how they are derived, which criteria are used and what the acceptability levels are.

The Handbook should describe qualitative and quantitative methods to derive the safety distances.

Contingency planning

In all countries contingency planning was reported to be a factor to consider. Most countries reported a leading role for the fire brigade in this area. The Fire Brigades are always a key actor. No specific emergency plan for HRS was mentioned during the interviews.

An emergency response plan should be included in the HyApproval Handbook. In this plan the intervention measures for the various incident scenarios at HRSs should be explicitly stated in the Handbook. Most of the interviewed parties indicated that they would like to see this

General recommendations:

Good coordination between the stakeholders in the approval process involved was seen as an important issue by the interviewees. This should also be emphasised in the Handbook, whereby it must be clear which authority has the coordination role. It is advisable that the parties involved seek agreement on potential discrepancies in an early stage. This includes Community relations. To facilitate community acceptance community concerns should be addressed as otherwise the implementation of the project could be seriously delayed, particularly because of the novelty of HRSs, with (certainly to the general public) unknown risks.

An inspection regime would have to be set in accordance with the risk imposed by the HRS. A number of countries reported that no specific inspection protocol exists. An (example of an) inspection regime should be given in the Handbook.

The use of the Handbook in the approval process of an HRS is not guaranteed as long as its status is not recognized. A statement from the competent authorities concerning the conditions under which they will endorse the use of the Handbook would be welcome.
In the medium to long term it certainly is advisable to develop the HyApproval Handbook to an EC Regulation or Directive.