Certification and approval procedures in Scandinavia for hydrogen fuelling stations and fuel cell electric cars

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H2moves Scandinavia and H2moves Oslo

SP Technical Research Institute of Sweden

Electronics

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Photos on the first page:
H2 Logic A/S (fuelling station Gaustad), Daimler AG (Mercedes-Benz B-Class F-CELL), Hyundai Motor Europe GmbH (Hyundai ix35 FCEV), H2 Logic A/S (Th!ink City Car with Fuel Cells)

Abstract

The increasing interest in hydrogen propelled fuel cell electric cars, has accentuated the need for suitable and transparent procedures for certification and approval of such cars and hydrogen fuelling stations.

This report describes the results of a study of certification and approval procedures in Sweden, Norway and Denmark, for gaseous hydrogen fuelling stations and hydrogen fuel cell electric cars.

The study is focused on identification of legislative actors and current certification and approval procedures in Sweden, Norway and Denmark, with the main focus on hydrogen fuelling stations, being an important prerequisite for the commercialization of hydrogen fuel cell electric cars. Based on case studies, possible obstructions for the commerzialisation have been identified and recommendations are given to facilitate the commerzialisation in Sweden, Norway and Denmark.

Key words:
hydrogen, hydrogen cars, hydrogen vehicles, hydrogen stations, hydrogen fuelling stations, hydrogen refuelling stations, H2moves Scandinavia, fuel cell cars, fuel cell vehicles, fuel cell electric cars, fuel cell electric vehicles

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Contents

Preface

This report describes the results of a study of certification and approval procedures in Sweden, Norway and Denmark for gaseous hydrogen fuelling stations and hydrogen fuel cell electric cars. The study is related to task T2.1 in work package WP2, project **H2moves Scandinavia** (H2mS) and **H2moves Oslo** (H2mO). The report is prepared under the leadership of SP Technical Research Institute of Sweden and constitutes deliverable D2.4 in WP2. The other task in WP2 (T2.2) has resulted in a "Safety and Emergency Plan" prepared by the partner TÜV SÜD Industrie Service GmbH, Germany.

The aim of the study is to facilitate commercialization of hydrogen fuel cell electric cars in Scandinavia, the availability of hydrogen fuelling stations being an important prerequisite for this. The study is focused on identification of legislative actors and current certification and approval procedures in Sweden, Norway and Denmark, with the main focus on hydrogen fuelling stations. Based on case studies, possible obstructions for the commerzialisation have been identified and recommendations are given to facilitate the commerzialisation in Sweden, Norway and Denmark.

Project partners in the consortiums for H2moves Scandinavia and H2moves Oslo are:

Partner	**H2mS**	**H2mO**
Bertel O. Steen AS, Norway		X
Daimler AG, Germany	X	
H2 Logic A/S, Denmark	X	X
Hydrogen Sweden	X	
Hydrogen Link , Denmark	X	
Hyundai Motor Europe GmbH, Germany	X	
LBST, Ludwig-Bölkow-Systemtechnik GmbH, Germany	X	X
SINTEF, Norway	X	X
SP Technical Research Institute of Sweden	X	X
TÜV SÜD Industry Services, Germany	X	X

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Summary

This report is related to studies of certification and approval procedures in Sweden, Norway and Denmark for hydrogen fuelling stations and hydrogen fuel cell electric cars. The studies have been focused on identification of legislative actors and legislation which regulates certification and approval procedures in Scandinavia, with main focus on safety aspects for fuelling stations. Based on case studies, possible obstructions for the commerzialisation have been identified and recommendations are given to facilitate the commerzialisation in Sweden, Norway and Denmark.

Additionally, a study has been made regarding possible regulatory restrictions in Norway for indoor parking of gas propelled cars.

Currently, harmonized EU rules related to safety requirements and conformity procedures for hydrogen fuelling stations, are not so well developed as for hydrogen fuel cell electric cars. A number of different EU provisions and national provisions applies for hydrogen stations and parts thereof. The national provisions fall under the responsibility of different national authorities and the EU Directives are implemented in different ways in the countries. This together with procedures which are not harmonized by EU provisions, contributes to a non-transparent and complex situation for the establishment of an infrastructure with hydrogen stations in Scandinavia.

1 Introduction

This report describes the results of a study of certification and approval procedures in Sweden, Norway and Denmark (designated “Scandinavia” in this report) for stationary gaseous hydrogen fuelling stations and gaseous hydrogen fuel cell electric cars. The aim of the study is to facilitate commercialization of hydrogen fuel cell electric cars, the availability of hydrogen fuelling stations being an important prerequisite for this. The study is focused on identification of legislative actors and legislation which regulates certification and approval procedures in Scandinavia. Based on case studies, possible obstructions for the commerzialisation have been identified and recommendations are given to facilitate the commerzialisation in Sweden, Norway and Denmark.

The study is related to certification and approval procedures for gaseous hydrogen fuel cell electric cars and fuelling stations with respect to safety aspects. Aspects related to hydrogen metering accuracy and hydrogen quality for gaseous hydrogen fuelling stations, are also considered in this study.

For hydrogen fuel cell electric cars, the study is focused on certification and approval aspects related to the use of gaseous hydrogen and fuel cell technology, for passenger cars (category M according to Annex II to Directive 2007/46/EC) to be used by the public (consumers). The study does not address other technologies e.g. aspects related to charging of batteries by connection to external mains supply.

For fuelling stations, the study is focused on certification and approval aspects related to the establishment of stationary hydrogen fuelling stations in Scandinavia, to be used by the public (consumers) to refuel hydrogen fuel cell electric cars. Provisions in force of general nature, common for conventional and hydrogen fuelling stations and cars, and provisions related to the transportation of hydrogen, are not addressed, or not addressed to the same extent.

Additionally, a limited study has been made regarding possible regulatory restrictions in Norway for indoor parking of gas propelled cars.

Sweden and Denmark are members of the EU. The EEA agreement 1994, between EU members states and EFTA member states (currently Norway, Iceland and Liechtenstein), allowed Norway to participate in the EU’s single market without being a member of EU. According to the agreement, Norway has adopted the EU legislation related to the single market, except those pieces of legislation that relate to agriculture and fisheries. Therefore, for fuelling stations and fuel cell electric cars, the same EU legislation applies for Sweden, Norway and Denmark.

This report does not address legislation related to the Seveso II Directive 96/82/EC (amended by Directive 2003/105/EC), as the amounts of hydrogen used in hydrogen fuelling stations normally do not fall within the scope of this Directive. The amount of hydrogen in such stations is normally well below the lower limit according to the Directive (5 ton).

The requirements and approval procedures for fuel cell electric cars are currently relatively well developed and harmonized compared with those for fuelling stations. The general view of the participating car manufacturers is also to prioritize questions related to the hydrogen infrastructure, to facilitate the establishment of hydrogen fuelling station network. Therefore, the study is focused on hydrogen fuelling stations.

The importance of developing the hydrogen infrastructure is also addressed by the Council and Parliament of the European Union in the European Regulation (EC) No 79/2009 for hydrogen-powered motor vehicles, which states:

"Hydrogen-powered vehicles are unlikely to be successful on the market unless adequate filling-station infrastructure is made available in Europe. The Commission should therefore look into suitable measures to support the establishment of a Europe-wide filling-station network for hydrogen-powered vehicles".

Each member state is responsible for establishing its own provisions, for safety aspects not regulated by EU or regulated by EU by minimum requirements only. For hydrogen fuel cell electric cars, a significant step has been made towards harmonizing of the rules, by the publication in 2010 of the European Regulations No 79/2009 and 406/2010 for hydrogen-powered motor vehicles.

In general, mandatory certification and approval requirements are given by legislative provisions, mainly comprising of:

- regulations issued by the European Commission, Council and Parliament
- national laws, ordinances and regulations issued by the parliaments, governments and authorities in the member states (which may implement directives issued by the Commission)

Member states are obliged to implement directives from the European Commission in their national legislation (national laws, ordinances and regulations). Regulations issued by the Council and Parliament of the European Union and by the European Commission, apply automatically and directly for all the member states, without being implemented in the national legislation.

For many regulations issued by the authorities in Sweden, Denmark and Norway, the authorities do also issue guidelines with recommendations on how to apply the regulations. Such guidelines are not legally binding, in contrast with regulations and other provisions which are legally binding. On the European Union level, the European Commission issues guidelines in a similar way for their directives.

For vehicles, global provisions such as Global Technical Regulation's (GTR's) from the United Nations Economic Commission for Europe (UN-ECE) need to be considered also, based on the 1958 and the 1998 Agreements of the UN-ECE. The European Commission is expected to continue supporting the development of internationally harmonised requirements for motor vehicles under the auspices of UN-ECE.

The national legislation for hydrogen stations and hydrogen fuel cell electric cars contains technical and organizational requirements related to equipment and constructions, as well as requirements related to procedures to be followed for verifying compliance and for approvals, licensing, permits, permissions, registrations and notifications. Requirements in the legislation are mandatory. Therefore, these requirements are of main interest for the study of certification and approval procedures.

2 Acronyms, abbreviations and terms

2.1 Acronyms and abbreviations

Some of the acronyms and abbreviations used in this report, are explained in the following table.

Table 2.1-1 Acronyms and abbreviations

ATEX User Directive	Directive 1999/92/EC on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
ATEX Product Directive	Directive 94/9/EC Equipment and protective systems intended for use in potentially explosive atmospheres
CPD	Directive 89/106/EEC Construction Products
EMC Directive	Directive 2004/108/EC Electromagnetic Compatibility (replaces 89/336/EEC)
FCEV	Fuel Cell Electric Vehicle
H2mS	H2moves Scandinavia
H2mO	H2moves Oslo
HRS	Hydrogen Refuelling station
LVD	Directive 2006/95/EC Low Voltage Directive (replaces 73/23/EEC)
MD	Directive 2006/42/EC Machinery (replaces 1998/37/EC)
MID	Directive 2004/22/EC Measuring Instruments
PED	Directive 97/23/EC Pressure Equipment
RTTD	Directive 99/5/EC Radio and Telecommunications Terminal Equipment
SPVD	Directive 2009/105/EC Simple Pressure Vessels (replaces 87/404/EEC)
TPED	Directive 2010/35/EU Transportable Pressure Equipment (replaces 99/36/EC)
Work equipment Directive	Directive 89/655/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work
Work sign Directive	Directive 92/58/EEC on the minimum requirements for the provision of safety and/or health signs at work

2.2 Terms

Some terms used in this report, shall be understood as following:

Harmonized standard
European standard issued by one of the European standardization bodies CEN (European Committee for Standardization) or CENELEC (European Committee for Electrotechnical Standardization) according to a mandate from the European Commission and the European Free Trade Association, and published by the Commission in the European Official Journal as a standard to provide one means of conformity with specified essential health and safety requirements of Directives issued by the European Commission.

Hydrogen fuelling station

There exist a number of terms for hydrogen stations, such as:
- hydrogen refueling station
- hydrogen refuelling station (HRS)
- hydrogen filling station
- hydrogen station
- hydrogen fueling station
- hydrogen fuelling station

In this report the term “hydrogen fuelling station” has been used, based on this term being used in the international Technical Specification ISO/TS 20100:2008 (Gaseous hydrogen – Fuelling stations). As a shorter form for this term, the term “hydrogen station” is used also in this report. For the purpose of this report, these terms shall be understood as stationary “gaseous hydrogen fuelling station“ according to ISO/TS 20100:2008.

Hydrogen fuel cell electric car

In this report the term “hydrogen fuel cell electric car” is used. As a shorter form for this term, the term “fuel cell electric car” is used also. For the purpose of this report, these terms shall be understood as fuel cell cars using compressed hydrogen as fuel.

Where the term “fuel cell electric vehicle” (FCEV) is used in this report, it shall be understood as referring to fuel cell electric car unless otherwise indicated by the context.

3 Certification and approval procedures for hydrogen fuelling stations – Safety aspects

3.1 Introduction

3.1.1 Background

Currently hydrogen fuelling stations are subject to different requirements and approval procedures in Sweden, Norway and Denmark. These differences are mainly related to building issues and the operation with flammable gas, and related to installations or parts of the fuelling station which are not subject to CE-marking according to EU product directives. These areas are regulated to a large extent by specific national legislations which are not regulated by EU.

Each country has its own laws, and a number of regulations laid down by different authorities, which cover different safety aspects, and which need to be complied with. For operators not familiar with the legislation in the countries, it is difficult to identify relevant provisions and applicable approval and permit procedures. This can cause difficulties in coordinating activities and approval procedures in an effective way for the Scandinavian market. The establishment of hydrogen stations, can therefore be a complicated process for operators not familiar with the national provisions. Lack of experience and lack of regulations and guidelines dedicated for hydrogen stations, do also contribute to the complexity and causes uncertainties.

To facilitate the commercialization of hydrogen fuel cell electric cars, the availability of hydrogen fuelling stations being an important prerequisite for this, there is a need to address a number of issues for hydrogen stations. An important first step is to identify relevant legislative actors and legislation for hydrogen stations in Sweden, Norway and Denmark. Based on this, furher considerations can be made on ways forward to facilitate the establishment of hydrogen stations.

3.1.2 EU provisions applicable for Scandinavia

3.1.2.1 General

European directives from EU are legally put into force in the member states by the member states themselves, by implementing the directives in their national legislation. The member states can decide by themselves, how the directives shall be implemented in their legislation. This applies for Sweden and Denmark being members of EU, and also for Norway according to the EEA agreement between the EU members states and EFTA member states. Therefore, Sweden, Norway and Denmark have implemented the European directives in different ways into their legislation.

According to the EEA agreement, some pieces of the EU legislation related to agriculture and fisheries do not apply in Norway. EU directives applicable for safety related aspects of gaseous hydrogen fuelling stations, apply equally in Sweden, Denmark and Norway.

The directives deal with hazards such as hazards related to explosion, fire, pressure and electricity.

EU directives applicable for safety related aspects of hydrogen stations, can roughly be divided into the following three categories:

1) Specific product directives, to be considered by manufacturers
2) User directives, with safety requirements for workers, to be considered by employers and owners
3) General product directives, concerning safety for consumers, to be considered by manufacturers

The term “manufacturer”, may also include distributors and importers. In certain cases also a user may become a manufacturer in the sense of a directive, and must fulfil obligations for manufacturers, for example if a user modifies a product in such a way that it should be considered as a new product according to the directive.

In addition to directives described above, there are directives for transportation of hydrogen to hydrogen stations (e.g. ADR Directive 94/55/EC and RID Directive 96/49/EC).

3.1.2.2 Specific product directives – safety for equipment

The 1st category of directives – specific product directives - are applicable for certain products, or products for certain use or associated with certain hazards. These directives describe both essential safety requirements to be fulfilled for the products and conformity procedures which must be followed. These requirements shall be fulfilled by the manufacturers who intend to put the products on the EU market.

With a few exceptions, these directives require CE-marking. The main aim is to allow the free movement of such products within the EU, and the member states are therefore not allowed to impose additional requirements which prevent the free movement. The conformity procedures according to these directives may, or may not, require involvement of notified bodies to verify compliance with certain requirements. Compliance with product directives, is normally indicated by a CE-marking affixed by the manufacturer and an EC Declaration of Conformity signed by the manufacturer. A directive may also cover products which are not complete in the sense of the directive, where the manufacturer shall attest compliance by other means than CE-marking.

Specific product directives for hydrogen stations:

- *67/548/EEC*
  Classification, packaging and labelling of dangerous substances
- *89/106/EEC - CPD*
  Construction Products
- *94/9/EC – ATEX Product Directive*
  Equipment and protective systems intended for use in potentially explosive atmospheres
- *97/23/EC – PED*
  Pressure Equipment
- *99/5/EC – RTTD*
  Radio and Telecommunications Terminal Equipment

- *2010/35/EU – TPED*
  Transportable Pressure Equipment (replaces 99/36/EC at latest 30 June 2011)
  (Pi-marking, no CE-marking)

- *2004/108/EC – EMC Directive*
  Electromagnetic Compatibility (replaces 89/336/EEC)

- *2006/95/EC – LVD*
  Low Voltage Directive (replaces 73/23/EEC)
  Note: Electrical equipment for use in an explosive atmosphere are outside the scope of LVD.

- *2006/42/EC – MD*
  Machinery (replaces 1998/37/EC)

- *2009/105/EC - SPVD*
  Simple Pressure Vessels (replaces 87/404/EEC)
  (pressurized with air or nitrogen)

3.1.2.3 User directives - safety for workers

The 2nd category of directives - user directives with safety requirements for workers – defines requirements on employers and owners related to the safety for certain work places (including installations) or for work places associated with certain hazards. These requirements are minimum requirements and member states are allowed to apply additional requirements. Such additional requirements might relate to organizational or technical requirements on work places, as well as requirements related to conformity procedures to be followed e.g. 3rd party inspections.

The minimum requirements according to these directives **and** any additional national requirements shall be fulfilled by the users (employers and owners).

User directives for hydrogen stations:

- *1999/92/EC - ATEX User Directive*
  Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres

- *89/391/EEC*
  Measures to encourage improvements in the safety and health of workers at work

- *89/654/EEC*
  Minimum safety and health requirements for the workplace

- *89/655/EEC - Work equipment Directive*
  Minimum safety and health requirements for the use of work equipment by workers at work

- *95/58/EEC*
  Minimum requirements for the provision of safety and/or health signs at work
  Note: Examples of signs are presented in picture 3.1.2.4-1 and 3.1.2.4-2 below.

- *98/24/EC*
  Protection of the health and safety of workers from the risks related to chemical agents at work

Picture 3.1.2.4-1 "No smoking and naked flames forbidden" prohibitory sign, according to Directive 95/58/EEC

Picture 3.1.2.4-2 "Flammable material or high temperature" warning sign according to Directive 95/58/EEC

3.1.2.4 General product directives - safety for consumers

The following directives are examples of general product directives to be considered by manufacturers, aiming at ensuring the safety for consumers:

- *2001/95/EC – GPSD*
  General product safety

- *85/374/EEC*
  Liability for defective products

3.2 Sweden

3.2.1 Legislative requirements

The Swedish legislation comprises of:
- Laws laid down by the Parliament
- Ordinances laid down by the Government
- Regulations laid down by the relevant authorities

Applicable laws (acts), ordinances and regulations for hydrogen fuelling stations are mandatory to fulfil and they implement applicable Directives from the European Commission. Regulations are intended to give more details on how to fulfil requirements in the laws and ordinances. Ordinances are based on laws (acts), and regulations are based on ordinances and laws (acts). The Swedish laws and ordinances can be found on http://www.notisum.se. From this place, there are also links to authorities and to all individual municipalities where local provisions applicable for the municipalities can be found.

Regulations, guidelines etc. can be found on homepages of the relevant authorities.

Authorities with regulations of particular interest for hydrogen fuelling stations are specified in the following table:

Table 3.2.1-1 Swedish authorities with regulations of particular interest for hydrogen fuelling stations

Authority (in Swedish)	**Authority (in English)**	**Abbre-viation**	**Home page**
Myndigheten för samhällsskydd och beredskap	The Swedish Civil Contingencies Agency	MSB [1)]	www.msb.se
Elsäkerhetsverket	The Swedish National Electrical Safety Board	ELSAK [1)]	www.elsakerhetsverket.se
Arbetsmiljöverket	The Work Environment Authority	AV [1)]	www.av.se
Boverket	The National Board of Housing, Building and Planning	BV [2)]	www.boverket.se
Kommun	Municipality (local authorities)		

[1)] This is a commonly used abbreviation
[2)] This is an abbreviation used for the purpose of this report

The National Board of Housing, Building and Planning (BV) issues national regulations related to buildings. The local municipality is the responsible authority for planning and building permits in the municipality. The requirements on planning and building are regulated by the law: SFS 2010:900 (“Plan- och bygglagen”) and the ordinance SFS 2011:338 (“Plan- och byggförordningen”), which include requirements concerning procedures, responsibilities and inspections related to building permits.

The authorities responsible for regulations and market surveillance according to product directives from EU (CE marking directives), which are of interest for hydrogen fuelling stations, are specified in the following table:

Table 3.2.1-2 Swedish authorities responsible for regulations and market surveillance according to EU product directives

Authority	**Directive**
The Work Environment Authority (AV)	- PED 97/23/EC - SPVD 2009/105/EC - Machinery Directive 2006/42/EC - ATEX Product Directive 94/9/EC
The Swedish National Electrical Safety Board (ELSAK)	- LVD 2006/95/EC - EMC Directive 2004/108/EC - ATEX Product Directive 94/9/EC
The Swedish Civil Contingencies Agency (MSB)	- TPED 2010/35/EU
The National Board of Housing, Building and Planning (BV)	- CPD 89/106/EEC

Legislation related to products and installations, of particular interest for hydrogen fuelling stations in Sweden, are compiled in section A1, Appendix A. Some of the laws, ordinances and regulations are wholly or partly based on Directives from the European Commission, as indicated in the table.

To fulfil legislative requirements in Sweden, there are a number of standards and guidelines which support the application of these requirements by providing more detailed information on how to fulfil the requirements. For legislative requirements based on EU Directives, guidelines and information on harmonized standards can be found on EU homepages for the different directives.

These guidelines and standards are strictly not to be considered as mandatory requirements, but represent generally acknowledged practice to fulfil essential health and safety requirements according to the legislation. Products which fulfil requirements according to standards published by the European Commission as a harmonized standard for a product directive, are presumed to fulfil the directive and the corresponding national legislation which implements the directive.

In addition to guidelines and standards produced by European standardization bodies, Swedish national guidelines can be found as:
- Advice to regulations published by authorities (normally published together with the regulation)
- Guidelines published by authorities, trade associations or other organizations
- Standards (other than European standards) or handbooks issued by Swedish standardization organizations
- Additional national information added in Swedish standards which transposes European Standards (EN)

Examples of such national guidelines of particular interest for hydrogen fuelling stations in Sweden are specified in the following table:

Table 3.2.1-3 National guidelines of particular interest for hydrogen fuelling stations in Sweden

Guideline/standard (in Swedish)	**Guideline/standard (in English)**	**Comments**
TSA 2010 Anvisningar för tankstationer för metangasdrivna fordon	TSA 2010 Guidelines for fuelling stations for vehicles using methane fuel	This guideline intends to address all applicable legislative requirements for stations providing methane fuel (bio methane and natural gas). It is published by the association: Energigas Sverige.
Hantering av brandfarliga gaser och vätskor på bensinstationer	Handling of flammable gases and liquids at petrol stations	This is a guideline to legislative requirements for petrol stations. It has been issued by the Statens räddningsverk [1)]
Räddningsverkets handbok om explosionsfarlig miljö vid hantering av brandfarliga gaser och vätskor	The Swedish Rescue Services Agency's guidelines on explosive atmospheres when handling flammable gases and liquids	This is a guideline to legislative requirements according to regulation SRVFS 2004:7. It has been issued by the Statens räddningsverk [1)]
[1)] This authority does not exist anymore and the responsibilities of this authority have been taken over by the Swedish Civil Contingencies Agency (MSB)		

The Swedish authority MSB has also a guideline for applicants seeking permit to handle flammable substances. A translation to English of this guideline can be found in Appendix B.

3.2.2 Approval procedures

3.2.2.1 Buildings, installations and handling hydrogen

This section deals with approval procedures for buildings, installations and handling hydrogen.

There are only a few examples of hydrogen stations which have been established in Sweden, and most of them are currently not in operation. However, there are experiences of approval procedures in many municipalities from establishing fuelling stations for vehicles using gas based on methane (bio methane and natural gas). Sweden has currently approx.135 such gas stations for public use, providing gas for approx. 39.000 vehicles. Experiences and procedures for these stations, should facilitate approvals of hydrogen fuelling stations as there are many aspects which need to be handled in the same way for hydrogen stations as for methane stations.

A building permit and a permit to operate with flammable gas is required from the local authorities (municipality). Before start of using flammable gas, inspection of the station by the local authorities is required also. No gas is allowed to be delivered to a hydrogen fuelling station until a written decision for operation has been received from the local building authority.

If the suggested location of the station does not suit the municipality's detailed development plan for the area, a longer procedure to change the plan needs to be undertaken. When applying for building permit, certified inspectors for inspection of the quality of the work, shall be specified in the application.

After approval of a new hydrogen fuelling station, the station shall be subject to certain periodic inspections. The foreseen procedure for approval of a hydrogen fuelling station are summarized in the following table:

Table 3.2.2.1-1 Principal steps foreseen for approval of a hydrogen fuelling station in Sweden based on the procedure for methane stations

Step	Activity
1	Planning and design of the hydrogen fuelling station. Consultation with the local building and fire authorities. Design inspection of the pressurized equipment (inspection to be performed by notified body, recognized 3rd party or manufacturer, according to AFS 1999:4, Table A1.3-1, Appendix A).
2	a) A written application to build a hydrogen fuelling station is submitted to the local building authority (municipality). The application shall include certain information and documents[1)], and be signed by the possessor of the property. b) A written application for handling flammable gas is submitted to the local authority (municipality)[2)]. The application shall include certain information and documents[3)], and be signed by the operator of the hydrogen fuelling station.
3	If the application for handling the flammable gas shows compliance with the legislation, the applicant receives a written permit from the local authority, which normally is valid for operation under 12 year The local authority shall communicate the permit (or rejection of permit) within 3 weeks after having received and confirmed a complete application.
4	The station is build up. The local authorities shall be notified in writing, about appointed person/manager and deputy concerning handling flammable gas.
5	Inspection of the installation by an accredited body, with respect to temperature compensation and penetration of air into compressors (according to SÄIFS 1998:5) [6)]. This requires often a temporary permit for trial operation with a flammable gas (before the final permit according to step 7 has been issued), from the local fire authorities.
6	Inspections on site; a) Inspection of the installed pressurized equipment, performed by the owner of the hydrogen fuelling station or by an accredited body (according to AFS 2005:3), for pressurized equipment or assemblies without CE-marking according to PED (AFS 1999:4) b) Inspection of the electrical installations, by a competent inspector e.g. an inspector authorized by Elektriska Nämnden [4)] c) Inspection by the local authority, with respect to handling a flammable gas (incl. verification that the inspections above have been passed) [5)] d) Inspection of the building, by the person appointed as responsible for the building quality
7	Following a successful inspection with respect to handling of flammable substances, the local authority issues a written permit for operation. The local authority for building permit issues a final receipt.
	[1)] This include: floor plan, elevations, layout drawings and fire safety documents. [2)] If the application is such that it will be sent by the local authorities to MSB for comments, it could save time to send the application directly to MSB in parallel with submitting the application to the local authorities. [3)]This include: description of the facility, the quantity handled gas, details on appointed person/manager (concerning handling of the gas), hazardous area classification plan, plan map where the distance to surrounding buildings shows, sketch of the station area

where the distance between the different parts of the station and cabling/wiring shows, drawings of buildings where ventilation of rooms with gas equipment shown, elevations, details of fire resistance rating of walls, doors and wall if any, operating and maintenance instructions, risk assessment in accordance with § 7 Law on flammable substances and explosives (SFS 2010:1011)

[4] "Elektriska Nämnden" is a committee within the Swedish Fire Protection Association (Brandskyddsföreningen Sverige), authorizing inspectors of electrical installations. Insurance companies require such inspectors to be used for insured facilities.

[5] The local authorities are not required by law to make an inspection, if they do not consider it necessary to make such an inspection.

[6] This applies for methane stations.

Note For large quantities of gas, additional aspects might be necessary to consider. For example, if the quantity exceeds 1 million Nm^3 per calendar year, the local authorities for environmental and health shall be notified. For stored volumes exceeding 5 ton, notification is required according to provisions (AFS 2005:19) which implement the Seveso Directive.

3.2.2.2 Equipment with CE-marking according to EU product directives

Approval procedures for the CE-marking of equipment comprise of conformity procedures described in the Swedish legislation which implement the applicable directives, see section A1, Appendix A. By affixing the CE-marking and signing an EC Declaration of Conformity, the manufacturer attests compliance with the requirements in the legislation and the directive, including requirements on conformity procedures which have to be passed.

Depending on products and directives, the involvement of notified bodies might be required for certification of products and/or certification related to quality assurance of the manufacturing of products (e.g. audits by the notified body of the manufacturer's quality management system).

CE-marked equipment in hydrogen fuelling stations shall therefore not be subject to further tests, assessments or inspections for approval by authorities, since the CE-marking shows compliance with the requirements.

However, inspections required by the authorities may relate to installation aspects and aspects related to the actual use of such products, to assess compliance with the intended use as defined by the manufacturer's instructions and marking of products and to assess compliance with applicable national installation requirements.

CE-marked products may be subject to market surveillance by relevant authorities. Such market surveillance may include testing and assessment of the products, as determined by the relevant authority.

3.3 Norway

3.3.1 Legislative requirements

The Norwegian legislation comprises of:
- Laws laid down by the Parliament
- Regulations laid down by the relevant authorities

Applicable laws (acts) and regulations for hydrogen fuelling stations are mandatory to fulfil and they implement applicable Directives from the European Commission. Regulations are intended to give more details on how to fulfil requirements in the laws.

This description addresses legislation of particular interest for hydrogen fuelling stations. It does not address the Norwegian island Svalbard, offshore units and associated process industry, where other provisions may apply. The Norwegian laws and regulations can be found on www.lovdata.no. Regulations, guidelines etc. can be found on homepages of the relevant authorities.

Authorities with regulations of particular interest for hydrogen fuelling stations are specified in the following table:

Table 3.3.1-1 Norwegian authorities with regulations of particular interest for hydrogen fuelling stations

Authority (in Norwegian)	**Authority (in English)**	**Abbre-viation**	**Home page**
Direktoratet for samfunnssikkerhet og beredskap	Directorate for Civil Protection and Emergency Planning	DSB [1)]	www.dsb.no
Direktoratet for arbeidstilsynet	The Norwegian Labor Inspection Authority	DAT [1)]	www.arbeidstilsynet.no
Direktoratet for byggkvalitet	Norwegian Building Authority	DIBK [2)]	www.dibk.no
Kommune	Municipality (local authorities)		

[1)] This is a commonly used abbreviation
[2)] This is an abbreviation used for the purpose of this report

Norwegian Building Authority (DIBK) issues national regulations related to buildings e.g. Regulation concerning buildings and constructional products for buildings FOR 1997-01-22 nr 33 (Forskrift om krav til byggverk og produkter til byggverk, TEK). The local municipality is the responsible authority for planning and building permits in the municipality. The requirements on planning and building are regulated by the law: Planning and Building Act LOV 2008-06-27 nr 71 (Plan- og bygningsloven), which include requirements concerning procedures, responsibilities and control related to building permits.

The authorities responsible for regulations and market surveillance according to product directives from EU (CE marking directives), which are of interest for hydrogen fuelling stations, are specified in the following table:

Table 3.3.1-2 Norwegian authorities responsible for regulations and market surveillance according to EU product directives

Authority	**Directive**
Directorate for Civil Protection and Emergency Planning (DSB)	- LVD 2006/95/EC - SPVD 2009/105/EC - EMC Directive 2004/108/EC - PED 97/23/EC - TPED 2010/35/EU - ATEX Product Directive 94/9/EC [1)]
The Norwegian Labor Inspection Authority (DAT)	- ATEX Product Directive 94/9/EC [1)] - Machinery Directive 2006/42/EC
Norwegian Building Authority (DIBK)	- CPD 89/106/EEC
[1)] This regulation is managed by DSB and DAT in cooperation, with DSB as coordinator. DSB is responsible for requirements related to flammable mist, vapour and gas. DAT is responsible for requirements related to combustible dust (not applicable for hydrogen stations).	

Legislation related to products and installations, of particular interest for hydrogen fuelling stations in Norway, are compiled in section A2, Appendix A. Some of the laws and regulations are wholly or partly based on Directives from the European Commission, as indicated in the table. To fulfil legislative requirements in Norway, there are a number of standards and guidelines which support the application of these requirements, by providing more detailed information on how to fulfil the requirements. For legislative requirements based on EU Directives, guidelines and information on standards can be found on EU homepages for the different directives.

These guidelines and standards are strictly not to be considered as mandatory requirements, but represent generally acknowledged practice to fulfil essential health and safety requirements according to the legislation. Products which fulfil requirements according to standards published by the European Commission as a harmonized standard for a product directive, are presumed to fulfil the directive and the corresponding national legislation which implements the directive.

In addition to guidelines and standards produced by European standardization bodies, Norwegian national guidelines can be found as:
- Advice to regulations published by authorities (may be published together with text from the regulation)
- Guidelines published by authorities, trade associations or other organizations
- Standards (other than European standards) or handbooks issued by Norwegian standardization organizations
- Additional national information added in Norwegian standards which transposes European Standards (EN)

Examples of such national guidelines of particular interest for hydrogen fuelling stations in Norway are specified in the following table:

Table 3.3.1-3 National guidelines of particular interest for hydrogen fuelling stations in Norway

Guideline/standard (in Norwegian)	Guideline/standard (in English)	Comments
VEILEDNING till forskrift 8. juni 2009 om håndtering av brannfarlig, reaksjonsfarlig og trykksatt stoff samt utstyr og anlegg som benyttes ved håndteringen	GUIDELINE to regulation 8. June 2009 concerning handling of flammable, reactive or pressurized substances, and equipment and facilities used for handling such substances	This is a guideline to the regulation 8. June 2009 (concerning handling of flammable…). It is issued by DSB. The text of regulation of 8. June 2009 is included in this guideline.
Temaveiledning om bruk av farlig stoff Del 1 Forbruksanlegg for flytende og gassformig brensel	Guideline concerning the use of dangerous substances Part 1 Facilities which consumes liquid and gaseous fuels	This is a guideline to the regulation 8. June 2009 (concerning handling of flammable…). It is issued by DBS.The guideline is focused on fuel consuming facilities such as facilities for heating and production of electricity.
Temaveiledning om omtapping av farlig stoff - Drivstoffanlegg - Fylleanlegg for propanflasker	Guideline concerning refuelling of dangerous substances - Fuelling stations - Fuelling facility for propane cylinders	This is a guideline to the regulation 8. June 2009 (concerning handling of flammable…). It is issued by DBS. It addresses, amongst other, hydrogen fuelling stations.
Temaveiledning om tilvirkning og behandling av farlig stoff - Prosesssanlegg - Biogassanlegg	Guideline concerning production and handling of dangerous substances - Process facilities - Biogas facilities	This is a guideline to regulation 8. June 2009 (concerning handling of flammable…). It is issued by DSB. It is focused on production of dangerous substances (e.g. flammable substances like hydrogen).
Veiledning til forskrift om trykkpåkjent utstyr	Guideline to regulation concerning pressurized equipment	This is a guideline to the regulation 9. June 1999 concerning pressurized equipment. It is issued by DSB. The regulation of 9. juni 1999 is included in this guideline.

3.3.2 Approval procedures

3.3.2.1 Buildings, installations and handling hydrogen

This section deals with approval procedures for buildings, installations and handling hydrogen.

A building permit is required from the local authorities (municipality). In certain cases the local building authorities may ask the municipality's local fire authorities for comments on building permit applications, for example if a fuelling station shall be built in a house with apartments. Since 8 June 2009, a permit to operate with flammable gases is not required from the local authorities, and the local fire authorities are not required to inspect stations before operation. The local building permit authority checks also with the Norwegian Public Roads Administration (NPRA), if they have any objections to the establishment of the station with respect to roads etc. Prior to the application of a building permit, neighbours shall be notified. They have two weeks, after the notification and after the application documents have been made available, to comment on the application.

The removal of the requirement on inspection and approval from the local fire authorities before putting a station into operation, is expected to liberate more resources for the fire authorities for supervision of the facilities.

If the suggested location of the station does not suit the municipality's detailed development plan for the area, a longer procedure needs to be undertaken to grant an exemption or change the plan.

When applying for building permit, the companies specified in the application which are going to do the work, need to be certified by Norwegian Building Authority (DBIK). The certification requirements on professional competence and quality assurance system, are intended to ensure that enterprises are eligible to accept responsibility for construction projects.

An approval from the national Directorate for Civil Protection and Emergency Planning (DSB), for handling flammable gases, is not required since 8 June 2009 according to the regulation FOR-2009-06-08 No. 602 (concerning handling of flammable, reactive or pressurized substances, and equipment and facilities used for handling such substances). Approval has been replaced by a requirement to notify and provide certain information to DSB, if the volumes containing hydrogen exceed 400 l (irrespective of the pressure). The information shall be registered electronically on DSB's homepage according to a guided procedure and within a reasonable time prior to the start of operation. The local fire authorities receive information from DSB on the notifications and they have the possibility to make inspections of the facilities if they wish so. The notification shall be made by a company registered in Norway.

A hydrogen fuelling station is considered as a facility with a high potential risk according to the regulation FOR-2009-06-08 nr 602 (§ 9). For such facilities the regulation requires inspections to be made of the station and its equipment concerning suitability and safety. The inspections shall be made by an independent:
- technical inspection body,
- user inspectorate, or
- accredited inspection body

The regulation requires also systematic inspections to be performed by an independent body concerning the condition of the station.

Other requirements according to the regulation, include performing a risk assessment (§ 14) and prepare documented plans for emergency preparedness and response (§ 19).

Other facilitates than a hydrogen fuelling station for hydrogen vehicles, e.g. wash hall or service hall with volumes containing hydrogen below 400 l (physical container volume regardless of pressure), need not to be notified to DSB according to FOR-2009-06-08 No. 602 (§ 12). However, when applying for building permits for such facilities, the local building authorities may consult DSB when processing such applications.

The procedure to establish a facility with gaseous fuel, is described by a flowchart in Appendix 1 in the Guideline concerning the use of dangerous substances
Part 1 Facilities which consumes liquid and gaseous fuels (see Table 3.3.1-1). An English translation of this flowchart is presented in Appendix C of this report. The flowchart is related to provisions for handling flammable substances and provisions for building permit.

3.3.2.2 Equipment with CE-marking according to EU product directives

Approval procedures for the CE-marking of equipment comprise of conformity procedures described in the Norwegian legislation which implement the applicable directives, see section A2, Appendix A. By affixing the CE-marking and signing an EC Declaration of Conformity, the manufacturer attests compliance with the requirements in the legislation and the directive, including requirements on conformity procedures which have to be passed.

Depending on products and directives, the involvement of notified bodies might be required for certification of products and/or certification related to the quality assurance of the manufacturing of products (e.g. audits by the notified body of the manufacturer's quality management system).

CE-marked equipment in hydrogen fuelling stations shall therefore not be subject to further tests, assessments or inspections for approval by authorities, since the CE-marking shows compliance with the requirements.

However, inspections required by the authorities may relate to installation aspects and aspects related to the actual use of such products, to assess compliance with the intended use as defined by the manufacturer's instructions and marking of products and to assess compliance with applicable national installation requirements.

CE-marked products may be subject to market surveillance by relevant authorities. Such market surveillance may include testing and assessment of the products, as determined by the relevant authority.

3.3.2.3 Case study – Hydrogen station (Gaustad) for fuel cell electric vehicles

The process to establish a 700 bar (70 MPa) hydrogen fuelling station for fuel cell electric vehicles (FCEVs), as experienced by a manufacturer and operator (H2 Logic A/S) of a hydrogen fuelling station and by the site responsible and project partner SINTEF, is summarized in Table 3.3.2.3-1 below.

The hydrogen station was established at Gaustad in Oslo, as part of the H2moves Scandinavia project. The station was located at a parking lot next to the facilities of SINTEF (research organisation). According to the municipality's detail development/zoning plan, the area at SINTEF is regulated for research activities which made it possible to speed up the approval procedure.

The station is intended to be used for refuelling of the FCEVs being demonstrated in the H2moves Scandinavia project. Whereas the parking area at SINTEF is open and the fuel dispenser/nozzle of the station is accessible to the public, the hydrogen production, storage and compression units are enclosed in the station and restricted by a wall with a locked entrance.

The station is owned, operated, maintained and monitored by the manufacturer H2 Logic A/S, with support from SINTEF personnel having their daily work at SINTEF's premises located next to the station. SINTEF has also contributed to the establishment of the station and the approval thereof by e.g. facilitating the local coordination of the entrepreneurs and drafting the compulsory information to the neightbours.

The manufacturer H2 Logic A/S was responsible for preparing the ground and for the

installations. To assist in the work with projecting and with the application for building permit to be submitted to the local authority, SINTEF was consulted and supported the process by e.g. engaging a Norwegian architect office with long experience with applications for building permits. A Norwegian contractor was hired for the ground work. Both companies were certified as required by the Norwegian Building Authority, for the work they should engage in.

Before the station components were transported to Oslo (in containers), the manufacturer engaged an inspection body to inspect pressure equipment of the station, at the manufacturers facilities in Herning, Denmark. A complementary third party inspection (including assessment of the hydrogen storage tanks) was performed on-site in Oslo in November 2011.

Table 3.3.2.3-1 Major steps in the process of establishing the hydrogen fuelling station

Date/Period	Activity
Fall 2010	Meetings and close dialogue between manufacturer H2 Logic and SINTEF was initiated to agree on the location of the hydrogen station at SINTEF's premises (Gaustad), including support during the establishment phase and maintenance assistance during operation of the station. The final agreement was signed September 26th 2011, allowing H2Logic to operate the station on SINTEF's ground to the end of 2014.
20 December 2010	An initial meeting was held with the local building permit authority at the local municipality, including: • Project presentation by the manufacturer and operator • Information and advice from the authority
January – May 2011	Activities during the period included: • Work to find suitable partners for projecting, ground work, installations etc. • Communication with the building permit authority. • Preparation of a building permit application by the manufacturer H2 Logic, which was sent to the local building permit authority. • Preparation of information to be sent out to the neighbours about the planned station (drafted by H2 Logic and SINTEF). The information was sent out by SINTEF on 15 April 2011 to the neighbours (including the municipality and Norwegian Public Roads Administration), with a possibility for them to raise potential objections within two weeks. No objections were received. • The manufacturer (H2 Logic A/S) was informed in May by the local permit authorities, that certain procedures have to be followed and that specific forms have to be filled in, and that the applicant of a building permit for an installation in Norway needs to be a Norwegian company. Therefore, upon the manufacturer H2 Logic's request of local assistance, SINTEF advised to engage a knowledgeable and experienced Norwegian architect office.
16 June 2011	A new application for building permit compatible with the requirements was developed by the architect office and SINTEF and submitted 2011-06-16 to the local building permit authority. To speed up the process a "one-step" simplified permit (instead of applying for a frame permit)was pursued, which must be handled by the authorities within 3 weeks, claiming the station is a research facility compatible with the existing detail development/zoning plan. This was done by applying for an establishment of the station as a temporary installation, based on non-commercial use for demonstration and research purposes in the three year project. Thereby the use was considered to be in line with the current detail development/zoning plan (stating research activities) for the actual area. An email from DSB which was attached to the application, confirmed that information regarding handling of hydrogen need to be registered on DSB's homepage (by a Norwegian company) and that no approval is required from DSB. Furthermore, an email from Oslo fire authority (OBRE) confirmed that no approval was required from them either.

July 2011	According to the Norwegian Building Act (§ 21-7, LOV-2008-06-27-71), the building permit can be considered as given by the local building permit authority in case they do not communicate otherwise (objections or similar) within three weeks after the local authority has received the simplified application. As no objections were received within three weeks, H2 Logic A/S interpreted this as an approval and that they therefore could start the work to build the station.
August - October 2011	The initial agreement with a local contractor was replaced by another certified contractor and the building permit authority was informed accordingly. During the period September to October, three weeks were used for the ground work. Approx. three days were used to receive and locate the three station modules (containers), and to raise the station walls. 11 days were used for installations. Totally, these activities to make the station ready for operation, required five weeks. SINTEF facilitated the work through local coordination of the contractors. During the installation, the manufacturer got information that a supplementary separate earth cable was required in the ground. The manufacturer suggested a specific earth cable, which was confirmed as acceptable. However, it turned out later that this cable was not acceptable and the cable was therefore replaced by another cable. Fortunately, there was an empty spare pipe in the ground which could be used for the earth cable.
17 October 2011	The handling of hydrogen was registered on DSB's homepage, with an employee at SINTEF registered as contact person.
14 November 2011	A third party set up control related to pressurized equipment of the station, was performed by a Norwegian inspection body (complementary to the third party inspection made on the manufacturer's facilities in Denmark, as mentioned above).
15 November 2011	The contractor issued a certificate dated 15 November, which confirmed that a final check has been completed without any remarks.
17 November 2011	An application for a certificate of completion, dated 17 November 2011, was sent by the architect office to the local building permit authority.
21 November 2011	Launch event for the station.
24 November 2011	The electrical installation was checked without remarks by a company providing electrical installation services, according to a checklist signed 24 November 2011.
5 December 2011	A report dated "Rev. 5.12.2011" related to pressurized equipment of the station was issued by a Danish inspection body, based on previous inspections made by the body at the manufacturer's facilities in Denmark and based on the complementary inspection on 14 November 2011 stated above, made by a Norwegian inspection body.
5 January 2012	A building permit dated 05.01.2012 was granted by the local building permit authority. The building permit was based on the assumption that the station is removed at latest on 1 December 2013.
31 January 2012	A certificate of completion was issued by the local building permit authority.

Manufacturer & operator experiences from the case

The following examples of unforeseen obstructions appeared for the manufacturer & operator (H2 Logic A/S), in the process of establishing the station:

1) H2 Logic A/S did experience some lack of competence by officials at the authority in charge of handling questions related to building permit, concerning issues related to hydrogen fuelling stations. However, H2 Logic A/S experienced an increasing competence by the officials as the permit process progressed.

2) When H2 Logic A/S applied for building permit, it became evident that it was not possible for H2 Logic A/S to apply for permit as they were not a Norwegian company. This was solved by using a Norwegian architect office as applicant, in a new application for the building permit. This caused extra costs and time.

3) For the ground work and installations, Norwegian companies certified by Norwegian Building Authority were needed. H2 Logic A/S experienced it problematic to not be allowed to do some of the work by themselves.

4) The use of a Norwegian consultant with experience from establishing hydrogen fuelling stations in Norway, was considered too expensive by H2 Logic A/S. This caused delays. Finally H2Logic got the information from the architect office engaged by SINTEF that it was not necessary to apply for an ordinary building permit as the area was classified for research activities (according to the municipality's detail development plan). This allowed for the hydrogen fuelling station to be established for research and demonstration purposes, based on a simplified building permit ("tiltak").

5) After completion of the ground work, the manufacturer & operator got the information that an additional earth cable was needed in the ground. Furthermore, the new cable which was confirmed as acceptable, turned out not to be acceptable according to the Norwegian regulations. This caused extra costs and time.

Looking back on the process, H2 Logic A/S experienced that time and costs could have been reduced significantly if a professional Norwegian company (the architect office) had been engaged earlier - from the beginning - in the building permit process.

3.3.2.4 Case study – Hydrogen station for fuel cell electric buses

The process to establish a 350 bar (35 MPa) hydrogen fuelling station for fuel cell electric buses, as experienced by a buyer of a fuelling station, is summarized in Table 3.3.2.4-1 below.

The fuelling station was ordered by buyer A from manufacturer B. The station was intended to be located on a bus terminal owned by A and intended to be used for fuelling buses owned by A. The area is available to the public, however, the hydrogen production, storage and compression units are enclosed by a wall with a locked entrance.

The fuelling station was intended to be owned and operated by the manufacturer B, however, the ownership was going to be transferred to the buyer A after five years. The buyer A is responsible for preparing the ground and for the installations of the station delivered by manufacturer B. To assist in the work with projecting, preparing the ground and installations, and with applying for building permits at the local authority, the buyer A engaged a Norwegian consulting firm C. To assist with a risk assessment (in addition to the risk assessment made by the manufacturer B), the buyer engaged a Norwegian agency D.

Table 3.3.2.4-1 Major steps in the process of establishing the hydrogen fuelling station

Date/Period	Activity
March 2010	An initial meeting was held with local building permit authority at the local municipality, including: • Project presentation by buyer A • Information and advice from the authority It was a requirement from the authority to have a meeting before applying for a building permit. A representative from DSB did also attend the meeting.
April 2010	There was a competitive tender of negotiations (negotiated tender). Six companies applied for prequalification.
June 2010	Final date in June for manufacturers to offer a hydrogen station. Offers from three manufacturers were received.
July 2010	An complementary inquiry was sent out to the three manufacturers, which emanated from discussions with them. The buyer take responsibility for the ground work and contacts with relevant authorities.
September 2010	Final date in September for manufacturers to make a complementary offer. Offers from three manufacturers were received.
October 2010	The offer from manufacturer B was accepted.
October 2010	Meeting with local building permit authority. Buyer A and his consultant C is informed about application for building permit and information to be provided with the application.
December 2010	Contract with the manufacturer B was signed.
February 2011	Report HAZID (hazard identification task) was received from agency D. The report was based on a workshop on 11 January 2011 and constitutes part of a risk assessment.
February 2011	Meeting with local fire authority. A representative from the operator with personal experiences from another hydrogen bus project - which had went through an approval process for a similar hydrogen station - attended the meeting and supported the parties with information and experiences from that approval process.
17 February 2011	A meeting was held with the local building permit authority at the local municipality.
May 2011	The application for building permit was submitted to the authority by the consulting firm C (with the manufacturer B as developer), in two parts: 1) Building permit for the buyer A, who is responsible for making the local

	site work and installations. The site work included road works, ground foundations including base plate, water and exhaust, and powering including a new transformer station. In addition to this, the buyer was responsible for building a wall intended to surround the station. 2) Building permit to the manufacturer B (manufacturer and operator of the station) for the station building, to be installed on the site prepared by buyer A. For both parts the buyer A was appointed as building proprietor. The application included also a preliminary quantitative risk assessment (QRA) from agency D (the risk assessment and explosion protection document from manufacturer B, was not available yet).
17 June 2011	An updated version of the preliminary quantitative risk assessment (QRA) was received from agency D. This was sent by the buyer A to the manufacturer B together with a request to the manufacturer to deliver their risk assessment.
August 2011	The final risk analysis was received from agency D, including requirements on safety distances and protective wall for the station. The buyer A requests the manufacturer B to consider any relevant information from the risk assessment made by agency C, and to provide a final risk assessment for the operation of the station and for the registration at DSB (as required by regulation FOR-2009-06-08 nr 602 concerning handling of flammable substances etc.).
29 August 2011	A frame building permit was granted by the local building permit authority. Following this frame permit, a building start permit is required for the different activities in the building process.
1 September 2011	Planned start for the local site work. However, the work could not start at this time as, amongst other, a building start permit for the ground work was not yet granted.
30 September 2011	A building start permit for the ground work, was granted by the local building permit authority.
3 October 2011	Local site work started (ground foundations, powering, road works etc.).
October 2011	The ground was found polluted by oil from a pump station, located earlier on the place. Clearing the contaminated ground required approximately four weeks extra work. Furthermore, unexpected pipes for district heating were found in the ground (these pipes were not specified in the maps). The foundation needs to be relocated.
Late October 2011	Risk assessment and the explosion protection documents were received from manufacturer B. The risk assessment made by manufacturer B was most relevant for the actual station. The manufacturer B was also going to build, own, operate and have the safety responsibilities for the station, and had carried out a more detailed and accurate risk assessment. The manufacturer B's risk assessment was used as basis for further construction works.
November - Dec 2011	Ground work was performed including dig for water pipes.
11 January 2012	A building start permit for the remaining work was granted by the local building authority. The relocation of the foundation was approved.
January - May 2012	The station was delivered and installed.
29 May 2012	The local building authority received documentation and information on the completed and operational station from consultant C, with a request to issue a certificate for the completed station. The certificate was issued on the same day by the authorities (29 May 2012).

Buyer experiences from the case

Based on experiences from establishing the hydrogen station described above, the following examples of unforeseen obstructions appeared for the buyer in the process of establishing the station:

1) The buyer experienced significantly different results from the risk assessments made by the agency D and manufacturer B. These differences caused extra efforts and time due to time consuming discussions and due to delays in the process caused by ambiguities concerning the risks. Such problems can be minimized by using common European standards and guidelines of good quality, which addresses the risks and protective measures for hydrogen stations.
2) To facilitate the handling and communication of issues with suppliers, agencies, consultants and authorities in an effective way, the buyer experienced it important to have some own competence and a person dedicated for handling issues related to the project through the whole project time. Lack of such competence and/or discontinuities by exchange of person, caused extra efforts and delays. The buyer did also experienced some lack of competence by officials at the authorities in charge of handling questions related to permits, concerning issues related to hydrogen stations.
3) In some cases the buyer experienced results of risk assessment and recommendations from suppliers of such services, to be too general or theoretical. The buyer wished to get more practical - hands on - recommendations related to the actual equipment and installations.
4) Following the first inquire period for offers from suppliers of hydrogen stations, a number of questions and issues came up with the suppliers. This caused an complementary inquiry which needed extra time for the process.
5) The buyer got extra work and the process needed extra time when it became clear during the process that the buyer had to take the role as building proprietor for the station.
6) The buyer thought that a documented risk assessment was needed for the application of the building frame permit. Therefore, such a risk assessment was ordered by an agency. However, it emerged that this was not necessary. Excluding this assessment would have reduced the time and costs for the permit application.
7) The buyer got extra work and the process needed extra time when oil contamination in the ground was discovered at the start of the ground work.
8) The buyer got extra work and the process needed extra time when unexpected pipes for district heating were discovered in the ground during the ground work. The station foundation needed to be relocated.
9) Complaints and questions from neighbours in conjunction with the process for building permit, took some time to handle.

An example of an activity which facilitated the approval process, was the involvement of a representative from the operator with personal experiences from a previous approval process for a similar hydrogen station and hydrogen buses. The buyer experienced it helpful to be accompanied and supported by this representative in a meeting with the local fire authorities.

3.3.3 Study regarding possible regulatory restrictions on indoor parking of gas propelled cars

3.3.3.1 Legal considerations

In addition to the study of certification and approval procedures for hydrogen stations and hydrogen fuel cell electric cars, a limited study has been made regarding possible regulatory restrictions in Norway for indoor parking of hydrogen fuel cell electric cars, as these cars are gas propelled. The term "parking room", used here, includes all kinds of indoor parking rooms for cars (including multi-story car parks and garages for public, private or other use). The following was found in this study:

The possible restriction is based on the following text according to the 4th paragraph in § 5, regulation FOR 2009-06-08 nr 602, Table A2.1-1, Appendix A (with reservations for any errors in the translation from Norwegian to English):

"Flammable gas category 1 and 2 shall not be stored in basements or other rooms below ground or in the attic."

In the explanatory notes to this requirement, the reason for this requirement is that basements and other rooms below ground often have bad ventilation and therefore might easier give rise to an explosive atmosphere.

In the Guideline concerning the use of dangerous substances Part 1 Facilities which consumes liquid and gaseous fuels (Table 3.3.1-3 above), the following additional information was found in 2010 (with reservations for any errors in the translation from Norwegian to English):

"Parking of gas propelled vehicles shall therefore not be allowed in parking rooms located more than 1 m below ground. This applies for parking rooms which are part of other buildings."

However, this information was removed in February 2011 upon publication of the current version (Version 2 – February 2011) of the Guideline concerning the use of dangerous substances Part 1 Facilities which consumes liquid and gaseous fuels.

According to information received from DSB in September 2012, the background for this change was that storage of flammable substances in vehicle fuel tanks is not within the scope of the regulation because this was not considered to be part of DSB's responsibility i.e. the regulation does not address vehicle fuel tanks. It is up to the owner of the parking room to decide on the use of the room, and the intended use need to be considered for the building permit of the parking room.

Other Norwegian legislation which may interact with this possible regulatory restriction, includes:

- For parking rooms at work places;
  Legislation based on EU directives 1999/92/EC, 89/391/EEC, 89/654/EEC and 89/655/EEC according to clause 3.1.2.3, with minimum requirements on employers e.g. the ATEX User Directive 1999/92/EC (FOR 2003-06-30 nr 911, Table A2.1-1, Appendix A) which require employers to make a risk assessment of workplaces and apply technical and organizational measures to make the workplace safe for workers with respect to explosion hazards.

- For cars;
  Legislation for general product safety and liability for malfunctioning cars, based on EU directives *2001/95/EC and 85/374/EEC* according to clause 3.1.2.3, with minimum requirements on manufacturers.

3.3.3.2 Flammability characteristics for hydrogen

From a technical point of view, the probability for an explosion in a parking room depends on the probability of occurrence of an explosive gas mixture and a sufficient strong ignition source at the same time and at the same place. The probability for an ignition depends also on how easily an explosive gas mixture can be ignited with respect to different ignition sources such as e.g. hot surfaces or electrical sparks (incl. electrostatic discharges). Furthermore, the required energy to ignite a mixture varies depending on the mixture (concentration of hydrogen in air).

The occurrence of an explosive gas mixture depends on factors such as:
- Ventilation
- Leakage/discharge rate of the gas
- Gas density
- Diffusion rate
- Flammability range (lower flammability limit to upper flammability limit)

How easily a gas mixture can be ignited, is characterized by explosion parameters such as:
- Auto ignition temperature (AIT) or Temperature class
- Minimum ignition energy (MIE) or Explosion group

A gas is classified in temperature class T1, T2, T3, T4, T5 or T6 depending on the auto ignition temperature (AIT), which describes the required temperature of a hot surface to cause an ignition of an optimum gas mixture in air.

Table 3.3.3.2-1 Temperature classes and AIT

Temperature class	Auto ignition temperature (ºC)
T1	> 450
T2	(300) – 450
T3	(200) – 300
T4	(135) – 200
T5	(100) – 135
T6	(85) – 100

A gas is classified in explosion group IIA, IIB or IIC depending on the minimum ignition energy (MIE) required by an electrical spark, to cause an ignition of an optimum gas mixture with air. Explosion group IIA requires most energy for ignition while explosion group IIC requires the smallest energy to ignite an optimum gas mixture.

The following table specifies explosion data of interest, when comparing different gaseous fuels and gasoline, with respect to the probability for an explosion in a parking room:

Table 3.3.3.2-2 Comparison of explosion data for some fuels

	Hydrogen	**Methane**	**Propane**	**Gasoline**
Density, relative to air	**0,07**	0,55	1,56	3,0
Diffusion coefficient in air (cm^2/s)	**0,61**	0,16	0,10 (LPG)	0,05
Flammability range (volume %).	**4,0 – 77,0**	4,4 – 17,0	1,7 – 10,9	1,4 – 7,6
Auto Ignition Temperature, AIT (ºC)	**560**	595	450	280
Temperature class	**T1**	T1	T2	T3
Minimum ignition energy, MIE (mJ), in air	**0,017**	0,274	0,240	0,240
Explosion group	**IIC**	IIA	IIA	IIA

Note: The data above are not well-defined due to uncertainties in the measurements and due to the method used for their determination. Where data is specified in IEC 60079-20-1:2010, such data has been used. For the specified explosion group (IIA) for gasoline, an ethanol concentration of not more than 5 % is assumed.

3.4 Denmark

3.4.1 Legislative requirements

The Danish legislation comprises of:
- Laws laid down by the Parliament
- Regulations laid down by the relevant authorities

Applicable laws (acts) and regulations for hydrogen fuelling stations are mandatory to fulfil and they implement applicable Directives from the European Commission. Regulations are intended to give more details on how to fulfil requirements in the laws.

This description addresses legislation of particular interest for hydrogen fuelling stations. It does not address Greenland and Faroe Islands, where other provisions may apply. The Danish laws and regulations can be found on www.retsinformation.dk. Regulations, guidelines etc. can be found on homepages of the relevant authorities.

Authorities with regulations of particular interest for hydrogen fuelling stations are specified in the following table:

Table 3.4.1-1 Danish authorities with regulations of particular interest for hydrogen fuelling stations

Authority (in Danish)	**Authority (in English)**	**Abbre-viation**	**Home page**
Sikkerheds-styrelsen	The Danish Safety Technology Authority	SIK [1)]	www.sik.dk
Arbejdstilsynet	The Danish Working Environment Authority	AT [1)]	www.arbejdstilsynet.dk
Beredskabsstyrel-sen	The Danish Emergency Management Agency	DEMA, BRS [1)]	www.brs.dk
Energistyrelsen [2)]	Danish Energy Agency [2)]	ENS	www.ens.dk
Erhvervsstyrelsen [3)]	Danish Business Authority [3)]	ERST, DBA	www.erhvervsstyrelsen.dk
Kommune	Municipality (local authorities)		

1) This is an abbreviation used for the purpose of this report
2) The former authority Danish Enterprise and Construction Authority which was responsible for regulations etc. related to building, construction products and CPD Directive 89/106/EEC, has ceased to exist.
3) The former authority National IT and Telecom Agency (ITST) which was responsible for regulations etc. related to radio and telecommunications terminal equipment and EMC Directive 2004/108/EC, has ceased to exist.

Danish Energy Agency (ENS) issues national regulations related to buildings e.g. "Bygningsreglementet" which came into force 1st December 2010 (BR10). The local municipality is the responsible authority for planning and building permits in the municipality. The requirements on planning and building are regulated by the law: LBK nr 1185 af 14/10/2010 Bekendtgørelse af byggeloven (Byggeloven).

The authorities responsible for regulations and market surveillance according to product directives from EU (CE marking directives), which are of interest for hydrogen fuelling stations, are specified in the following table:

Table 3.4.1-2 Danish authorities responsible for regulations and market surveillance according to EU product directives

Authority	**Directive**
The Danish Safety Technology Authority (SIK)	- LVD 2006/95/EC - ATEX Product Directive 94/9/EC
The Danish Working Environment (AT)	- ATEX Product Directive 94/9/EC - Machinery Directive 2006/42/EC - PED 97/23/EC - SPVD 2009/105/EC - TPED 99/36/EC and 2010/35/EU
Danish Energy Agency [1)] (DEMA)	- CPD 89/106/EEC
Danish Business Authority (DBA) [2)]	- EMC Directive 2004/108/EC

[1)] The former authority Danish Enterprise and Construction Authority which was responsible for regulations etc. related to building, construction products and CPD Directive 89/106/EEC, has ceased to exist.

[2)] The former authority National IT and Telecom Agency (ITST), which was responsible for regulations etc. related to radio and telecommunications terminal equipment and EMC Directive 2004/108/EC), has ceased to exist.

Legislation related to products and installations, of particular interest for hydrogen fuelling stations in Denmark, are compiled in section A3, Appendix A. Some of the laws and regulations are wholly or partly based on Directives from the European Commission, as indicated in the table.

To fulfil legislative requirements in Denmark, there are a number of standards and guidelines which support the application of these requirements, by providing more detailed information on how to fulfil the requirements. For legislative requirements based on EU Directives, guidelines and standards can be found on EU homepages for the different directives.

These guidelines and standards are strictly not to be considered as mandatory requirements, but represent generally acknowledged practice to fulfil essential health and safety requirements according to the legislation. Products which fulfil requirements according to standards published by the European Commission as a harmonized standard for a product directive, are presumed to fulfil the directive and the corresponding national legislation which implements the directive.

In addition to guidelines and standards produced by European standardization bodies, Danish national guidelines can be found as:
- Advice to regulations published by authorities (e.g. “vejledning”, “anvisning” and “meddelelse”)
- Guidelines published by authorities, trade associations or other organizations
- Standards (other than European standards) or handbooks issued by Danish standardization organizations
- Additional national information added in Danish standards which transposes European Standards (EN)

The following guideline is an example of a guideline published by the Danish authority DEMA, intended to support the application of regulation BEK nr 1444 of 15/12/2010 (Ordinance on Technical Requirements for gases):

Table 3.4.1-3 National guidelines of particular interest for hydrogen fuelling stations in Denmark

Guideline/standard (in Danish)	Guideline/standard (in English)	Comments
Vejledning til tekniske forskrifter for gasser Brandforebyggelse Vejledning nr. 15	Guideline to technical regulations for gases Fire prevention Guideline No.: 15	The guideline was published 23 December 2010 and applies mainly for gas storing facilities.

3.4.2 Approval procedures

3.4.2.1 Buildings, installations and handling hydrogen

This section deals with approval procedures for buildings, installations and handling hydrogen.

A building permit and a permit to operate with flammable gas is required from the local authorities (municipality). Applications for building permit are handled by the local building authorities, and permits for operation with hydrogen are handled by the local fire authorities. Building permit requires, amongst other, an emergency plan for the station and safety distances in compliance with the requirements.

Depending on the maximum amount of hydrogen stored at the fuelling station, a permit might be required also from the Danish Emergency Management Agency (DEMA). The regulation BEK nr 1444 and the Guideline to technical regulations for gases, Fire prevention, Guideline No.: 15 (see Table 3.4.1-3), specifies the amount of flammable gases which require a permit from the local authorities (municipality) and from DEMA, respectively. Section 1.4 of the guideline defines such limits for the amounts and describes also information to be provided in applications for permit.

If the suggested location of the station does not suit the municipality's detailed development plan for the area, a longer procedure to change the plan needs to be undertaken.

Experiences from permit applications have shown that meetings with representatives of the local authorities, before submitting applications for a building permit and a permit to operate with hydrogen, have facilitated the process to obtain permits. Involving representatives from other municipalities, where permits have been received earlier for other fuelling stations, in such meetings, may facilitate the process further.

The procedure to establish a hydrogen fuelling station, as experienced by a manufacturer and operator, is summarized in five steps according to the following table:

Table 3.4.2.1-1 Principal steps for approval of a hydrogen fuelling station as experienced by a manufacturer and operator

Step	Activity
1	Start of dialogue • Initial meeting with local city authorities – presentation scope • Dialogue with city authorities involved in previous stations (exchange of experiences between city authorities)
2	Authority Approval • Submission of application for permit for building & operation Local municipality & fire brigade – potentially also national authorities • Placement of station based on international safety distance standards • Station design based on national & international regulations & standards
3	Local site works • Building permit granted by local municipality • Local works at site – foundations, powering, road works etc.
4	Station installation • Installation of station equipment • Conduction of operation tests – final granting of operation permission
5	Station Opening

3.4.2.2 Equipment with CE-marking according to EU product directives

Approval procedures for the CE-marking of equipment comprise of conformity procedures described in the Danish legislation which implements the applicable directives (see section A3, Appendix A). By affixing the CE-marking and signing an EC Declaration of Conformity, the manufacturer attests compliance with the requirements in the legislation and the directive, including requirements on conformity procedures which have to be passed.

Depending on products and directives, the involvement of notified bodies might be required for certification of products and/or certification related to quality assurance of the manufacturing of products (e.g. audits by the notified body of the manufacturer's quality management system).

CE-marked equipment in hydrogen fuelling stations shall therefore not be subject to further tests, assessments or inspections for approval by authorities, since the CE-marking shows compliance with the requirements.

However, inspections required by the authorities may relate to installation aspects and aspects related to the actual use of such products, to assess compliance with the intended use as defined by the manufacturer's instructions and marking of products and to assess compliance with applicable national installation requirements.

CE-marked products may be subject to market surveillance by relevant authorities. Such market surveillance may include testing and assessment of the products, as determined by the relevant authority.

3.5 Summary

3.5.1 Conclusions

The procedure for permit to handle and operate with flammable gases (hydrogen) is different in Norway, Denmark and Sweden. In Sweden and Denmark the operators need to apply for such a permit at the local authorities (municipality). For certain amounts of gas, permit from the national authority is required in Denmark. Furthermore, the limits for the amount of gas which require permits, varies between the countries. In Norway, permit is not required. However, for hydrogen amounts exceeding 400 l (physical container volume regardless of pressure) the operator need to notify and to provide certain information to the national authority (DSB), prior to the start the operation. According to a regulation in Norway, the operator is required to engage an independent inspection body to assess suitability and safety for the station and its equipment. The regulation requires, amongst other, a risk assessment to be performed for the fuelling station.

The principal procedure to acquire a building permit for hydrogen fuelling stations is similar in Norway, Sweden and Denmark and follows the same route as for other fuelling stations. In all three countries, a building permit is required from the local building authorities in the actual municipality. Differences relate for example to different requirements on certified contractors, installers and inspectors.

Experiences from Denmark have shown that meetings in an early stage with representatives of the local authorities, before submitting applications for building permit and permit to operate with hydrogen, have facilitated the process to obtain permits. Involving representatives from other municipalities where permits have been received earlier for other hydrogen fuelling stations, in such meetings, has also facilitated the permit process.

In a case in Norway, the applicant of a building permit was accompanied by a representative from an operator - with experience and documentation from establishing a similar hydrogen fuelling station - at a meeting with the local Norwegian fire authorities. This was considered helpful for processing the permit.

Equipment installed in the hydrogen fuelling station, with CE-marking according to EU Directives, need not to be assessed or approved in the three countries. However, such equipment shall be installed, used and maintained as intended by the manufacturer, according to the marking and accompanying instructions.

Applicable regulations in the country, for installation, use and maintenance, need to be considered. Requirements according to such regulations are only harmonized in part by EU Directives, as such directives only provides minimum requirements, and may therefore differ between the countries. Even if the regulations or supporting standards state the same requirements, difficulties can arise due to different practices or interpretations of requirements.

Some applicants of building permit, have experienced delays caused by limited knowledge or experience (of hydrogen and hydrogen fuelling stations) by the permit handling authorities. Therefore, there is a need for training, education and support for such authorities, specifically for officers in charge of handling such permits.

In a case in Norway, the buyer experienced significantly different results from the risk assessments made by an agency and by the manufacturer respectively, for the same

hydrogen fuelling station. These differences caused extra efforts and time to establish the station and put it into operation. The buyer did also experienced results of risk assessment and recommendations from agencies to be too general or theoretical in some cases. These problems can be minimized by using common European standards and guidelines of good quality, which addresses the risks and protective measures for hydrogen stations to a sufficient detailed level.

Differences in risk assessments reflects different philosophies. One philosophy may assume worst case scenarios including explosion hazard without laying emphasis on detailed measures applied on equipment to avoid explosions (e.g. due to lack of detailed information on measures applied on equipment level) while another philosophy may exclude or minimize explosion hazard based on such detailed protective measures applied for the equipment.

A Danish manufacturer experienced that the building permit process in Norway for a hydrogen fuelling station, would be significantly shorter and less expensive by using a professional Norwegian company from an early stage, to assist in the building permit process. Preferably this could be the company engaged for projecting. They did also experienced it difficult to not be allowed to do some of the ground work and installations by themselves, as certified Norwegian companies were required to do such work according to the applicable provisions.

To be considered also, is that if permit procedures are relaxed such that the active role of the permit authorities is reduced, this could cause difficulties for the authorities to attain and maintain competence in the area, unless compensated by other means e.g. by training and/or increased active role in the surveillance of hydrogen stations and associated products and installations.

3.5.2 Recommendations

In order to facilitate the establishment of hydrogen fuelling stations in Norway, Denmark and Sweden - to facilitate the commercialization of hydrogen fuel cell electric cars - measures according to Table 3.5.2-1 are recommended concerning safety-related approval procedures.

Besides the ongoing hydrogen activities in Norway, Denmark and Sweden, such activities are also ongoing in other Nordic countries such as Finland and Iceland. Considering the similarities between the Nordic countries with respect to regulatory and climatic conditions, and considering existing forums for cooperation for the Nordic countries, it would be beneficial to coordinate activities which are common for all Nordic countries.

Involvment of all Nordic countries will also facilitate possible support from the Nordic Council (Nordic parliamentary cooperation body). Aligned and transparent requirements in the Nordic countries for hydrogen stations, may also contribute in standing out the North European Region as a strong and early market for hydrogen cars, with climatic conditions which will enforce the development of a durable and competive fuel cell technology for fuel cell cars.

An alignment of the national provisions in non EU-regulated areas, in the North European Region, might also serve as a pilot for EU on how to facilitate the establishment of hydrogen stations on the European level, by suitable common provisions for the whole EU. Such provisions might in principal be useful also for other kind of infrastrucure and facilities, which need to be established in Europe for the generation, storage, consumption or delivery of renewable energy.

Table 3.5.2-1 Recommended measures to facilitate the establishment of hydrogen stations in Norway, Denmark and Sweden

Measures	**Comments**
Support and facilitate for manufacturers and operators of hydrogen stations to identify applicable legislative requirements, approval procedures and relevant authorities in Norway, Denmark and Sweden The relevant associations in Sweden, Norway and Denmark - for operators and manufacturers of hydrogen stations – to jointly develop a Guideline in cooperation with relevant authorities in their countries. The guideline should be based on the coming international standard ISO 20100 as far as possible and any national differences should be minimized and clearly specified.	An example of a similar work done on national level is the guideline for methane fuelling stations in Sweden. This guideline was developed by the Swedish Gas Association in cooperation with regulators, operators and manufacturers in Sweden. This current report from the H2moves Scandinavia project, provides also some guidance to manufacturers and operators in identifying legislative requirements and approval procedures in Norway, Denmark and Sweden. It presents also experiences and learnings from some real cases of establishing hydrogen fuelling stations, which can be used to facilitate further establishment of stations.
Provide means for relevant regulatory and approval authorities in Norway, Denmark and Sweden to regularly exchange experiences and information related to hydrogen fuelling stations, and to jointly: a) compare and align their national regulations related to hydrogen fuelling stations as far as possible b) develop – as far as possible - common guidelines including checklists on how to handle approval and permit applications for hydrogen fuelling stations, to be used by local and other authorities appointed to handle such applications c) ensure that requirements (technical as well as administrative and procedural requirements) are easy to find and transparent on the homepages of the approval authorities in the three countries, in languages which are commonly understood by manufacturers and suppliers located outside the Scandinavian countries. If possible, create focal points on the home pages for hydrogen fuelling stations, with overview information on, and links to, applicable provisions, guidelines, application forms, permit and approval procedures etc.	The alignment within Scandinavia of national regulations should also consider alignment of regulatory requirements concerning qualifications and certification/accreditation of professional companies providing services such as projecting, ground work, installations, risk assessment and inspections of hydrogen stations, Such an alignment (e.g. by applying the same requirements and certification systems as far as possible) will facilitate free movement of such services within Scandinavia, increase the market for companies providing such services and facilitate the establishment of hydrogen stations at lower costs due to higher competition. An example of a guideline developed on national level, is the Swedish guideline for authorities handling permit applications for fuelling stations for methane vehicles (Tankstationer för metangasdrivna fordon). This guideline (including a checklist) was developed by the national authority MSB, to be used by the local authorities (municipality) when handling applications for the permit to operate such stations. Example of focal points can be found on the home page of The Work Environment Authority (AV) in Sweden. For a number of industries and work activities, packages of applicable regulations are presented.
Support and encourage regulatory and approval authorities in the Nordic countries to align national regulations and approval procedures related to hydrogen stations, in common Nordic forums within the field of activities for the Nordic Council. Encourage the Nordic Council and the Nordic Council of ministers to prioritize and support such work.	Examples of an existing forum for the Nordic countries, is the Nordic committee for co-ordination of questions related to electrical safety (NSS). Participators in NSS are representatives from the authorities for electrical safety in Sweden, Denmark, Norway, Finland, Iceland, the Faroe Islands and Greenland. Another such Nordic committee exist which deals with issues related to the ATEX Directive.

In a longer term, ways forward may include further means and tasks for relevant authorities in Sweden, Norway and Denmark to allow for closer cooperation and sharper targets than recommended in the table above, in order to eliminate national differences in legislative requirements and approval procedures.

If the European Commission considers to impose provisions on all the member states in order to accelerate the development of a hydrogen fuelling station network in EU, experiences from establishing fuelling stations in Scandinavia described in this report, might be helpful to consider.

Based on information from car manufacturers, a general problem is indicated regarding compliance with SAE TIR J2601 for hydrogen fuelling stations, when pre-tested by the car manufacturers with the manufacturer's hydrogen fuel cell cars, even for stations which are in compliance with this SAE specification according to the manufacturers of the stations.

Pre-testing of many stations by different car manufacturers, is not a sustainable solution to such a problem. Therefore, it is recommended that the European Commission consider provisions which require acceptance tests according to SAE TIR J2601 (re. fuelling protocols related to refuelling time, pre-cooling, IR-communication etc.), to be performed on-site by independent bodies for each installed hydrogen fuelling station. For series produced stations, produced under a quality assured production regime, type verification performed by indepent bodies should be considered combined with suitable limited on-site tests for each installed station prior to putting the station into operation. Suitable checks on-site on regular basis - during the station life time - should be considered also.

It is recommended that the European parties with interest in this subject, ensures that the applicable SAE-specifications for hydrogen fuelling stations and dispensers, together with appropriate verification methods thereof (e.g. acceptance test, type verification and on-site tests mentioned above), are considered in the coming international key standard described below for hydrogen fuelling stations. In case appropriate European requirements can not be included in the international standard, it should be considered whether such requirements should be included as European Common Modifications in the European implementation of the international standard. The impact of such differences between Europen standard and standards for other regions, need to be considered as well.

The availability of recognized and harmonized standards for hydrogen stations and parts thereof, are important elements to facilitate the establishment of hydrogen fuelling stations. Such standards for the hardware, should specify requirements for construction, marking and accompanying instructions, and how to verify compliance with these requirements by tests, inspections etc. The standards need to meet the minimum or the essential health and safety requirements stated in the legislation. Such standards are normally not legally binding in Scandinavia and Europe, for equipment subject to CE-marking according to the European new approach directives. Therefore, strictly, from a legal point of view, other specifications may also fulfil the essential health and safety requirements in the legislation. However, if other specifications than national recognized standards have been applied, difficulties may arise in demonstrating compliance with the legislative requirements. Therefore, national standards (based on international standards) which are recognized in the country are important.

Such standards should be of a quality which enable designers and verifyers to achieve sufficient details, on how to design and verify equipment to fulfil the legislative requirements. Furthermore, they should be usable without allowing significant differences

in interpretations of the requirements. They should also be in a form which can be used for verification by first, second or third parties.

For a standard for hydrogen fuelling stations, it is important - based on learnings from the H2moves project - to specify adequate requirements for risk assessments which eliminate or reduce differences in the way of performing and reporting such risk assessments. The requirements and assessment methodology in the standard, should also be detailed to a level which ensures repeatability in order to eliminate or reduce differences in the outcomes of such risk assessments.

To facilitate global harmonization, the standards in Europe and Scandinavia for hydrogen stations and parts thereof should be based on international standards as far as possible. Therefore, it is important for European and Scandinavian stakeholders, including relevant authorities, to act in the international standardization bodies such as ISO and IEC, to ensure that provisions in Europe and Scandinavia for hydrogen stations and parts thereof will be addressed adequately in the standard.

A key standard for hydrogen fuelling stations is the Technical Specification ISO/TS 20100 Gaseous hydrogen – Fuelling stations (at the time of publication of this report, this standard is subject to revision). The ongoing work to revise ISO/TS 20100 and transfer this specification into an international ISO standard (ISO 20100), and further on to an European EN standard, is an important step to facilitate establishment of hydrogen stations. Important requirements to agree on in this standard, include requirements on safety distances for hydrogen fuelling stations and requirements on equipment influencing such safety distances. Other important aspects to be considered, are requirements related to SAE-acceptance testing and risk assessment as mentioned above.

In case pre-normative work or research is needed for the standard, or funding is needed to ensure adequate European participation to cover European needs in the international work on the standard, it is recommended that the European Commission considers funding of such work.

To identify any further needs for European provisions, to facilitate the commercialization of hydrogen stations, a gap analysis can be made by checking how each safety-related requirement in the coming standard ISO 20100 is covered by requirements in the EU Directives for products according to section 3.1.2.2 above. In case of any gaps (requirements specified in the standard are not adequately addressed in the Directives), needs for European provisions can be considered if such provisions would facilitate the commercialization. In case requirements in the standard are addressed by more than one of the EU Directives for unjustified reasons, amendment of the Directives can be considered to simplify or avoid possible conflicts. The gap analysis can be extended to cover also non-safety related requirements in the standard (to be compared with requirements in non-safety related EU provisions), which might have an impact on the commercialization of hydrogen stations.

Such a gap analysis will also provide information on which EU Directives the corresponding European standard, or part thereof, should be harmonized for. The analysis can also be used as a tool to check that requirements for hydrogen stations in applicable Directives, are addressed by the standard.

To achieve international standards with good quality, the engagement of competent persons in the standardization work should be ensured. Ideally such a competence should cover:
- good technical competence in the actual area
- good insight into any current problems in the actual area

- good knowledge in applicable European provisions
- good knowledge in standards writing
- experiences of verification (testing, assessment etc.) of the actual requirements
- an ability to put such knowledge and experiences into practice in cooperation with others when developing an international standard

The recommendations above related to approval procedures concerning safety aspects for hydrogen stations – to facilitate the commercialisation of fuel cell vehicles - can be summarized as following:

- *Operators and manufacturers of hydrogen stations in Sweden, Norway and Denmark should – through their relevant associations and in cooperation with the relevant authorities - jointly develop a common Guideline concerning applicable provisions and approval procedures in the Scandinavian countries.*

- *Support to the relevant authorities to enable regularly exchange of experiences and information, and support for aligning applicable regulations (incl. approval procedures) between Sweden, Norway and Denmark as far as possible, and support to develop a common guideline (as far as possible) for authorities on handling applications for approvals and permits.*

- *Extend the work recommended above, to include all Nordic countries (incl. Finland and Iceland) using common Nordic forums within the field of activities for the Nordic Council.*

- *EU Commission should support establishing a harmonized European standard for hydrogen fuelling stations based on the coming international standard ISO 20100.*

- *EU Commission should consider provisions which require the fuelling protocols for hydrogen stations to be tested on-site by independent bodies.*

Furthermore, the following is recommended concerning standardization:

- *European stakeholders should consider a strong European focus and involvement in the development of the international standard ISO 20100 for hydrogen fuelling stations, to ensure that appropriate requirements are included related to e.g. safety distances, risk assessment, fuelling protocols (according to SAE TIR J260) and related test methods.*

4 Certification and approval procedures for hydrogen fuelling stations – Hydrogen quality

4.1 Introduction

4.1.1 Background

The quality of the hydrogen is very important when it is used as fuel in a fuel cell vehicle. This can easily be underestimated when planning the supply and production systems. The chapters below describe the main requirements and legislative aspects.

4.1.2 Production of hydrogen

Hydrogen used for hybrid hydrogen cars can be produced in many different ways. **Steam reforming** can be used to generate hydrogen from fossil fuel such as natural gas or other mixes of hydrocarbons (liquid or gas). The efficiency for these processes is approximately 80 %. Unfortunately steam reforming produces a significant amount of CO_2 gas. The majority of hydrogen used today is produced from fossil fuel by steam reforming.

Hydrogen gas can also be produced from water by different methods. The most common method is **electrolysis** where water and electrical power is used to produce the hydrogen. There are two advantages with this method, there is no production of any greenhouse gases and there is no impurity in the hydrogen created by this process. The efficiency of the electrolysis is approximately 50-70%.

The hydrogen can be produced locally at the hydrogen refuelling station or being transported to the station by truck, train or pipelines. The local production can be divided into on-site reformers and on-site electrolysers.

4.1.3 Performance aspects

The National Institute of Standards and Technology (NIST) is an agency of the U.S. Commerce Department. As a part of the standardisation work for the fuel supply for hydrogen fuelled vehicles NIST describes the performance aspects.

The performance of hydrogen-fuelled vehicles is dictated by the performance of the fuel cell, which in turn is affected by the quality of the hydrogen gas used. Several contaminants have been identified that will decrease the performance of the fuel cell. Among these are hydrogen sulphide (H_2S), carbonyl sulphide (COS), methyl mercaptan (CH_3SH) and ammonia (NH_3). Currently, there are no nationally recognized standards for these components either in nitrogen or hydrogen as the balance gas. NIST's objective is to develop accurate, stable standards of these components in balance nitrogen, then in balance hydrogen. In this way the quality (purity) of the hydrogen used for vehicles can be accurately determined.

Several contaminants, in particular sulphur-containing compounds, have been identified that will be detrimental to the performance of the hydrogen fuel cell. NIST has begun the development of standard preparation and analytical methodology for: hydrogen sulphide (H_2S), carbonyl sulphide (COS), methyl mercaptan (CH_3SH) and ammonia (NH_3). NIST participated in an ASTM Committee D03 round robin study of sulphur compounds in nitrogen.

The commercial standards for hydrogen that is delivered to the fuelling stations (bulk delivery, on-site generation, on-site purifier off H2 pipeline) are generally Grade 5.0 in Europe and 4.5 in USA.

The most common used fuel cell technique is the proton exchange membrane (PEM) fuel cell vehicle. This fuel cell technology is sensitive to certain impurities in the hydrogen. Both Society of Automotive Engineering (SAE) and International Organization for Standardization (ISO) are engaged in the work to establish standards for hydrogen used for PEM fuel cells.

4.2 EU provisions applicable for Scandinavia

The quality of the hydrogen delivered to fuelling stations is not specified by any legislative authorities in Europe.

It could be noted in this context, that Regulation No 406/2010 issued by the European Commission, specifies the following gas composition used for type-approval testing of hydrogen-powered vehicles:
" Compressed hydrogen gas used for testing shall comply with, or be of greater purity than, the Type 1, Grade A gas composition specified in ISO/TS 14687-2."

4.3 Other international provisions and standards

4.3.1 The Society of Automotive Engineers International (SAE)

This is an organization established by people involved in the development of technique for vehicles. The main base for this organization is USA and it has members from most of the industrial countries. The organization is issuing a lot of standards and a various number of technical articles.

4.3.1.1 SAE standard J2719

This standard was first issued 2005-11 and was last revised 2011-09.

The standard provides a hydrogen quality standard for commercial proton exchange membrane (PEM) fuel cell vehicles. The purpose is to specify hydrogen fuel quality requirements for all commercial hydrogen fuelling stations for PEM fuel cell vehicles.

The content of this standard has been coordinated with the ISO workgroup TC 197/WG12 (H2 Fuel – product specification working group) handling the ISO 14687 Part 2 standard. See also the information below regarding ISO.

4.3.2 Organization for Standardization (ISO)

The ISO organisation is defined as a non-governmental organisation but do have strong connections to the various governments. The members are often responsible for the national standardisation work. The ISO standards are used by almost all of the countries globally.

4.3.2.1 ISO standard ISO/FDIS 14687-2

This part of ISO 14687 describes the grades of hydrogen intended for road vehicles with Proton exchange membrane (PEM) fuel cells. These grades (Type I, grade D and Type II, grade D) are intended to be applied to the interim stage on a limited production scale.

The standard describes the requirements (classification, applications and limiting characteristics) and the quality verifications for the hydrogen used.

The ISO Technical committee ISO TC 197 is responsible for the development of this standard. The first edition of the standard was issued 2008-03-01. In the introduction to the standard it is mentioned that it is expected that the technology for the fuel cell vehicles will develop rapidly and also that vehicle demonstration projects will give more technical information.

The Technical committee ISO TC 197 is in the process of finalising a new issue of this standard. The final draft is now out for voting. The voting terminates on 2012-11-14. The content of the new issue of this standard is confidential for all parties outside of the committee.

4.3.2.2 ISO draft international standard ISO/DIS 20100

The ISO draft international standard ISO/DIS 20100 (Gaseous hydrogen – Fuelling stations), is under development by Technical Committee ISO/TC 197 (Hydrogen technologies) and is intended to replace the international technical specification ISO/TS 20100:2008. The draft standard issued for voting 2011-03-21, specifies Type I, Grade D as defined in ISO 14687-2 to be used for vehicles with proton exchange membrane (PEM) fuel cells. Grades A, B or C shall be allowed only if means of preventing the fuelling of PEM vehicles with these grades are provided.

4.4 Sweden

4.4.1 Legislative requirements

The quality of hydrogen fuel from fuelling stations is currently not regulated by any provisions in Sweden.

The Swedish Board for Accreditation and Conformity assessment (SWEDAC) is not involved in any legislation regarding any fuel quality.

The ISO standardisation work in Sweden is performed by Swedish Standard Institute (SIS) which is a full member of the ISO organisation.

4.4.2 Approval procedures

No approval procedures exist currently.

4.5 Norway

4.5.1 Legislative requirements

Currently, no legal requirements exist regarding the purity of hydrogen.

4.5.2 Approval procedures

There is currently no national approval procedure in Norway regarding the hydrogen quality.

4.5.3 Case study and learnings – Pre-tests by Daimler

Daimler performed a pre test of the fuel filling process in Oslo at the Økern fuelling station. These tests were done during the period from February to July 2011. It was noted obvious signs of particulates in the hydrogen fuel delivered to the cars. A lot of activities were started up during the summer to try to solve the problem. Tubes were cleaned and various filters were either replaced or cleaned. During the period from August 2011 up to today over 500 hydrogen fuel fillings have been performed without any more indications of particulate problems.

The results from the analysis performed showed particles of chrome-nickel-steel and oxidised iron (rust). Traces of small particles of nickel, aluminium and copper were also identified. The largest particle size found was 250 µm.

The fuel filling equipment is built up to secure a delivered fuel without large particulates. During refuelling, hydrogen goes through three filters on the way from the storage vessels to the car: a 1 µm filter, a 15 µm filter and a 40 µm filter.

It is not possible to make a 100% safe conclusion, but all indications point out that the cause of the problem was lack of cleanliness during the installation of the various equipment in the fuel filling station. The station in Kjellstad, which is identical to this one, never had any similar problems.

4.6 Denmark

4.6.1 Legislative requirements

Currently, no legal requirements exist regarding the purity of hydrogen.

4.6.2 Approval procedures

There is currently no national approval procedure in Denmark regarding the hydrogen quality.

4.7 Summary

4.7.1 Conclusions

The requirements concerning the quality of the hydrogen are similar in the whole Scandinavia and also similar to the rest of Europe. The requirements are not dictated by national regulations but are only dictated by the SAE and ISO standards.

The standardisation seems to be well coordinated between the SAE Standardisation work and the ISO standardisation work. The layout of these standards are different but the technical content is basically identical.

4.7.2 Recommendations

The recommendations for facilitating the future commercialisation of fuel cell vehicles are basically the following:

- Secure extremely care regarding the cleanliness of the inside areas of all ingoing parts (such as tubes, tanks, hoses, connections) that will transport hydrogen in the new fuelling station.
- Particulate filters should be placed as close to the fuelling delivery point as possible to secure the quality of the fuel delivered to the vehicles.
- Secure that SAE J 2719 and/or ISO/TS 14687-2 are fulfilled for all hydrogen used. Both for the hydrogen produced locally and the hydrogen delivered from other production sites.
- Secure quality systems to regularly analyse the quality of the hydrogen and also according to the methods described in the standards.

5 Certification and approval procedures for hydrogen fuelling stations – Hydrogen metering accuracy

5.1 Introduction

5.1.1 Background

It is essential that correct and traceable measuring instruments are used to secure correct delivery of fuel during fuelling of a vehicle. New types of fuels require new technique for these measuring instruments.

The usage of hydrogen is now starting up in various demonstration projects both in Europe and outside Europe. The experience from usage of hydrogen as fuel for vehicles is still very limited.

The previous technology allowed a maximum fuelling pressure of 350 bar (35 MPa) for the compressed hydrogen. This project is using technology allowing the hydrogen to be delivered in the state of compressed gas at a pressure of up to 700 bar (70 MPa).

5.1.2 Technology for measuring delivered fuel

The density of a fluid may change with temperature, pressure, or the composition of the fluid. This is very obvious when the fluid is in the state of gas. Therefore the measurement principle must be to measure the mass flow instead. The device used is named inertial flow meter or coriolis flow meter. In the typical mass flow meter the fluid is contained in a tube with no moving parts that would need to be cleaned and maintained, and that would impede the flow.

A typical mass flow meter can be seen below.

5.2 EU provisions applicable for Scandinavia

The European Parliament have issued the Directive 2004/22/EC on measuring instruments. The aim with the directive can shortly be described with the following sentences taken from the introduction chapter in the directive:

"*Correct and traceable measuring instruments can be used for a variety of measurement tasks. Those responding to reasons of public interest, public health, safety and order, protection of the environment and the consumer, of levying taxes and duties and of fair trading, which directly and indirectly affect the daily life of citizens in many ways, may require the use of legally controlled measuring instruments.*"

Article 1 in the directive states for which types of measuring instruments this directive shall be applied to according to the instrument specific attachments MI-001 up to MI-010.

Annex MI-002 lists the types of gas meters and volume conversion devices for which this directive is applicable. The relevant requirements of Annex I in the directive apply to gas meters and volume conversion devices intended for residential, commercial and light industrial use. Gas meters and volume conversion devices for fuelling stations for vehicles are not included in this annex which means that the Directive 2004/22/EC is not applicable for them.

According to information given there is no indication that the Directive 2004/22/EC will be changed to include also gas meters and volume conversion devices for fuelling stations in the near future.

5.3 Other international provisions and standards applicable for Scandinavia

5.3.1 OIML

OIML (Organisation Internationale de Métrologie Légale) (International Organisation of Legal Metrology) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its member states.

In Europe OIML R117 is pointed out in the Official Journal as one way of fulfilling the requirements in MID.

5.3.1.1 OIML R 117-1 ed 2007: Dynamic measuring systems for liquids other than water

This recommendation specifies the metrological and technical requirements applicable to dynamic measuring systems for quantities (volume or mass) of liquids other than water subject to legal metrology controls.

5.3.1.2 OIML R 137-1 ed 2006: Gas Meters, Part 1 Requirements

This recommendation applies to gas meters based on any principle, used to meter the quantity of gas in volume, mass or energy units that have passed through the meter at operating conditions. It applies also to gas meters intended to measure quantities of gaseous fuels or other gases, except gases in the liquefied state and steam.

5.3.1.3 OIML R 139 ed 2007: Compressed gaseous fuel measuring systems for vehicles

This international recommendation specifies the metrological and technical requirements applicable to compressed gaseous fuel measuring systems for vehicles, at type-approval, initial verification and subsequent verifications.

This OIML is not referred to today from the MID.

5.3.1.4 OIML R 140 ed 2007: Measuring system for gaseous fuel

This recommendation applies to measuring systems for gaseous fuels:

- with a designed maximum flow rate *Q*max equal to or greater than 100 m^3/h at base conditions and for operating pressures equal to or greater than 200 kPa (2 bar) absolute;
- not fitted with diaphragm gas meters. It may apply to very large measuring systems located at the border between two countries as well as to smaller measuring systems, with the exception of measuring systems for compressed natural gas for vehicles (CNG).

5.4 Sweden

5.4.1 Legislative requirements

SWEDAC is the authority with regulations for fuel metering accuracy, for the Swedish market.

Table 5.4.1-1 Swedish authority responsible for regulations related to fuel metering accuracy

Authority (in Swedish)	**Authority (in English)**	**Abbre-viation**	**Home page**
SWEDAC Styrelsen för ackreditering och teknisk kontroll	SWEDAC Swedish Board for Accreditation and Conformity Assessment	SWEDAC [1)]	www.swedac.se
[1)] This is a commonly used abbreviation			

Fuel meters for liquid fuel have to fulfil the regulation STAFS 2006:9 issued by Swedac and directly connected to MID 2004/22/EC. This requirement covers measuring systems for continuous and for dynamic measurement of quantity of other liquids than water.

OIML R117 is use in this process by reference to it in the Official Journal.

Meter accuracy for fuel meters distributing fuel in the state of gas, is not covered by any regulations in Sweden today. Fuels that are in the state of gas when they are filled in a fuel station are not covered by the MID directive.

The OIML's recommendations R 139 (Compressed gaseous fuel measuring systems for vehicles) are probably used by the manufacturers of the metering equipment on a voluntary basis.

Regarding fuel meters for gas, the prediction is that it will take long time until any regulations will be issued regarding metering accuracy. The scenario for the future is:

- No legislations issued at all
- Awaiting the on-going activities at EU-level

5.4.2 Approval procedures

Currently no approval procedures exist. Fuels that are in the state of gas when they are filled in a fuel station are not covered by the MID directive.

5.5 Norway

5.5.1 Legislative requirements

Justervesenet (JV) is the authority with regulations for fuel metering accuracy. JV is a governmental agency under the Ministry of Trade and Industry, and is responsible for the Norwegian metrology infrastructure and for ensuring its national and international acceptance.

Table 5.5.1-1 Norwegian authority responsible for regulations related to fuel metering accuracy

Authority (in Norwegian)	Authority (in English)	Abbre-viation	Home page
Justervesenet	Norwegian Metrology Service	JV [1)]	www.justervesenet.no
[1)] This is a commonly used abbreviation			

Justervesenet is the Norwegian authority in the following areas:

- Authorised to prepare Norwegian regulations in the area of legal metrology. In some cases the regulations are decided by the Department of Industry and Trade, in most cases the decision is with Justervesenet.
- All measuring instruments used under the regulated area must have been subject to a conformity assessment before they are put in operation. Justervesenet is a notified body for MID.

There are Norwegian regulations for some other categories of instruments, not covered by these directives. Such regulations are: “Dynamic weighing instruments for vehicles”, “Dip level gauges for tank measurements” and some other regulations. For instruments according to these regulations, the conformity assessment consists of a type-approval and an initial verification. Both shall be carried out by Justervesenet.

Regular verification/inspection is done by Justervesenet to insure correct measurements over time. In most cases it is done periodically: for gasoline meters the period is one year, for most weighing instruments the period is three years.

Meter accuracy for fuel meters distributing fuel in the state of gas is not covered by any regulations in Norway today.

Decisions taken by the Ministry of Trade and Industry during 2011 were to not include legislation for gas metering accuracy.

5.5.2 Approval procedures

Currently no approval procedures exist. Fuels that are in the state of gas when they are filled in a fuel station are not covered by the MID directive.

5.6 Denmark

5.6.1 Legislative requirements

Danak was previously the authority to issue regulations regarding fuel metering accuracy for the Danish market. From 1st of April 2010 Sikkerhedsstyrelsen is the authority responsible for regulations for fuel metering accuracy. They have taken over the responsibility to administrate the complete area of metrology. Danak shall continue to assist in this work.

Table 5.6.1-1 Danish authority responsible for regulations related to fuel metering accuracy

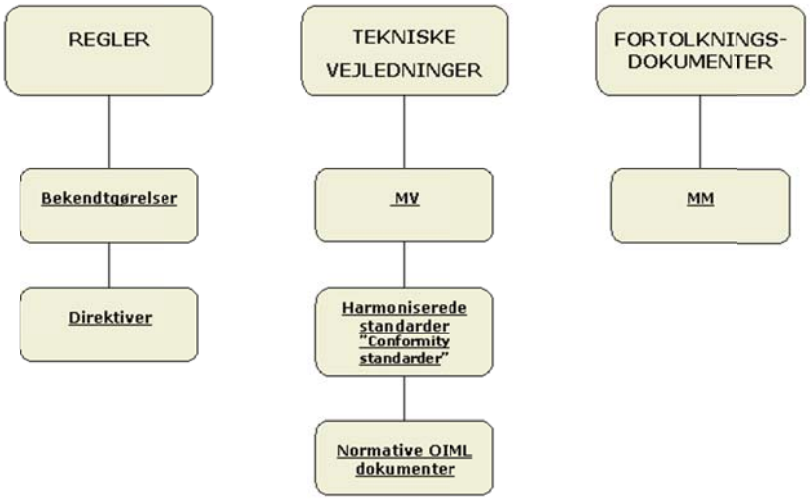
Authority (in Danish)	**Authority (in English)**	**Abbre-viation**	**Home page**
Sikkerheds-styrelsen	The Danish Safety Technology Authority	SIK [1)]	www.sik.dk
[1)] This is an abbreviation used for the purpose of this report			

The administration made by Sikkerhedsstyrelsen of this accreditation area is from 1st of January 2010 based on the EU-directive regarding accreditation and market follow up. This is made in close co-operation with Danak.

The MID-directive Annex MI-002 “Gas meters and volume conversion devices” applies also for gas meters for the automotive sector in Denmark.

OIML R 139 “Compressed gaseous fuel measuring systems for vehicles” will probably be used when the first system will be put on place.

Overview of the legislative structure for Denmark:



5.6.2 Approval procedures

Sikkerhedsstyrelsen is the approval authority for the Danish market. A decision has been taken that the approval procedure shall follow the MID Directive Annex MI-002 “Gas meters and volume conversion devices”.

5.7 Summary

5.7.1 Conclusions

The MID Directive 2004/22/EC is applied fully for the Scandinavian countries. This directive is applicable for the measurement requirements for fuelling of vehicles with fuels in the state of liquid but not applicable for fuelling of vehicles with fuel in the state of compressed gas.

In Denmark a decision was taken that the MID-directive Annex MI-002 “Gas meters and volume conversion devices” applies also for gas meters for the automotive sector in Denmark.

The OIML R 139 is applicable on a voluntary basis in Norway and Sweden and on a mandatory basis in Denmark.

5.7.2 Recommendations

The recommendations for the future commercialisation of fuel cell vehicles are basically the following:

- The Directive 2004/22/EC should be updated to be applicable also for gas meters and volume conversion devices for hydrogen fuelling stations.
- OIML R139 should be updated with special demands applicable for hydrogen and technology needed.

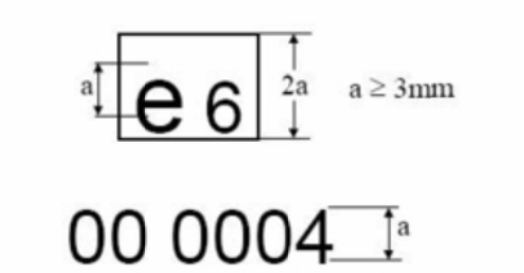
6 Certification and approval procedures for hydrogen fuel cell electric cars – Safety aspects

6.1 EU provisions applicable for Scandinavia

The European **Regulation (EC) No 79/2009** for hydrogen-powered motor vehicles, addresses legislative requirements for hydrogen fuel cell electric cars. This regulation was issued by the European Parliament and the Council and it came into force on 24 February 2011 for all EU member states including Sweden and Denmark. This regulation is relevant also for Norway according to the EEA agreement. The regulation applies directly for all member states including the Scandinavia countries, without the need for any further legislative actions in the countries.

Following Regulation No 79/2009, the European Commission has issued **Regulation No 406/2010** which specifies details related to administrative provisions for EC type-approval, technical requirements, test procedures, labelling, identification etc. of hydrogen-powered vehicles. The regulation shall be used together with the **Framework Directive 2007/46/EC** for the approval of motor vehicles, which is applicable since 29 April 2009.

Regulation 79/2009 covers hydrogen-powered vehicles (categories M and N according to Directive 2007/46/EC) with hydrogen used as liquid or used as compressed gas. The regulation has a similar structure as the current Regulations 67 (LPG) and 110 (CNG) issued by the United Nations Economic Commission for Europe (UN-ECE). The regulation covers also hydrogen components and systems for hydrogen-powered vehicles, intended to be put separately on the market. Such components and systems shall be marked according to Regulation No 406/2010, see example of marking according to the following picture:



Picture 6.1-1 Example of EC component type-approval mark issued by Belgium (6) under number 0004. The first two digits (00) indicate approval according to Regulation No 406/210

The regulations 79/2009 and 406/2010 requires new hydrogen-powered vehicles - and hydrogen components and systems for such vehicles - to comply with the requirements in the regulations and to be type-approved. By these regulations, a single approval of a hydrogen fuel cell car in any member state in Europe is sufficient to bring such new cars, components and systems to Norway, Sweden and Denmark. The regulation aims also to guarantee that the cars meet equivalent levels of safety as those for conventional vehicles.

New vehicles, components and systems which have been certified earlier and which do not fulfil the requirements in the regulation, are not allowed to be registered.

Other applicable EU provisions include:
- **Regulation (EC) No 661/2009** Concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefore

- **Council Directive 72/245/EEC** (and its amendments incl. Commission Directive 2006/28/EC) relating to the radio interference (electromagnetic compatibility) of vehicles

For cars with on-board transmitters such as mobile phones, Bluetooth, WLAN etc., provisions according to the following directive applies:
- **Directive 1999/5/EC** on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity

As for battery powered electric cars, electrical safety for the electric power train need to be considered also for fuel cell electric cars, considering the electric system which include fuel cells, batteries and electric motor. These safety aspects are addressed by ECE Regulation No 100 of the UN-ECE (Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train), published 2.3.2011 in the Official Journal of the European Union.

At international level, a GTR (Global Technical Regulation) based on Japanese regulations is under development by an initiative involving Japan, EU and USA. The GTR is developed within UN-ECE, with the aim to smoothen regulatory differences worldwide. If this GTR will be adopted, it will be put into force in Europe and other regions, possibly with some regional variations concerning some elements. Regional variations can e.g. relate to different expected life time for on board pressure vessels in different regions, depending on a different national inspection schemes for cars in use.

Hydrogen fuel cell electric cars are, as other cars and consumer products, covered by legal requirements aiming to ensure that consumer products placed on the market are safe. As for other countries in Europe, the Scandinavian countries have provisions which implement the General Product Safety Directive 2001/95/EC (GPSD). GPSD obligates manufacturers to place “safe” products on the market, and complements any sector directives, with such sector directives having preference over the GPSD.

The European type-approval framework Directive 2007/46/EC currently recognizes and authorizes vehicle approval under four different schemes:
- European whole vehicle type-approval
- European small series type-approval (only available for M1 category vehicles)
- National small series type-approval
- National individual vehicle-approval

The technical requirements for the European type-approval schemes are contained within 2007/46/EC itself, whereas the technical requirements for the National approval schemes are left to the discretion of each Member State.

The National Individual Vehicle Approval (IVA) scheme option is intended to cater for vehicles registered in the lowest volumes, such as amateur built vehicles, low volume sports cars and specialist vehicle conversions. However, these National IVA schemes are also used to obtain approval for mass produced vehicles from countries outside the European Union (e.g. USA, Japan and China).

Due to the large number of such vehicles being imported into the European Union, the European Commission has harmonized the technical and administrative requirements for

the IVA, for M1 and N1 category vehicles "produced in large series in or for third countries". This "European" Individual Vehicle Approval scheme has been harmonized by amendment of the European type-approval framework Directive 2007/46/EC and by Commission Regulation (EU) No. 183/2012 which came into force on 26 February 2012.

The new technical and administrative requirements for the European IVA are introduced as a new Appendix to Annex IV and a new European IVA approval certificate format is introduced into Annex VI of Directive 2007/46/EC.

The new technical requirements for European IVA are based on the technical requirements for full European whole vehicle type-approval, but include a number of exemptions and relaxations. Furthermore, in instances where the regulations applicable in the country of origin of the vehicle have been recognized as providing a level of road safety and environmental protection which is at least equivalent to the European technical requirements, evidence of compliance with these third country regulations will be accepted for European IVA.

6.2 Sweden

The authority responsible for regulations, type-approval and registration of cars in Sweden is specified in the following table:

Table 6.2-1 Swedish authority responsible for type-approval and registration of cars (incl. hydrogen fuel cell electric cars)

Authority (in Swedish)	Authority (in English)	Abbre-viation	Home page
Transportstyrelsen	The Swedish Transport Agency	TS [1)]	www.transportstyrelsen.se
[1)] This is an abbreviation used for the purpose of this report			

In addition to the harmonized procedures for approval of hydrogen fuel cell electric cars based on EU provisions according to clause 5.1 above, Sweden does also have procedures for national type-approval. Regulations, guidelines etc. can be found on the homepage of the Swedish Transport Agency.

To be able to register a car and get license plates, the car need to be approved by TS in Sweden. One of the following approvals applies:
- Type-approval
- Individual approval

Type-approval

There are two types of type-approval:
- EU vehicle type-approval
- National type-approval

EU vehicle type-approval
When a manufacturer has received such an approval for the car model, this approval applies in all EU countries. A car with an EC type-approval is supplied with a manufacturer's plate that contains the car’s approval number. Furthermore, the manufacturer shall certify with a CoC (Certificate of Conformity), that the car is covered by an EU type-approval. Such a CoC is required for new cars which are not registered in their country of origin. The registration inspection of such a new car does not include any technical check, however the car and the documentation will be identified. However, for

used cars with CoC, technical checks are made at the registration inspection.

National type-approval
For series produced cars of standard design, that have been approved, registered and used in another EEA country, a registration certificate from that country is enough to show compliance with the safety requirements in Sweden.

If there is no valid CoC, but a type-approval is shown by the registration document and manufacturer's plate on the car, the car is approved without having to apply the exemption for own use. The same applies if there is a valid CoC, regardless of whether the car has been registered previously in another EU country or whether the vehicle is new or used. There is no restriction on the number of vehicles that may be brought in.

Individual approval

As from 1 March 2012 an individual approval is required for new cars without type-approval. The harmonized technical and administrative requirements contained in Commission Regulation (EU) No. 183/2012 applies. This means that the former procedure in Sweden to attain an approval from an inspection body based on a registration inspection at the body, is no longer possible to use. The responsibility for such approvals has been transferred to The Swedish Transport Agency.

Individual approval applies for new cars imported to or manufactured in Sweden, which has not been registered or used in another EU country. The approval is based on an inspection made by an inspection body. The inspection shall verify compliance with all applicable requirements and verify the technical identity of the car.

6.3 Norway

The authority responsible for regulations, type-approval and registration of cars in Norway is specified in the following table:

Table 6.3-1 Norwegian authority responsible for type-approval and registration of cars (incl. hydrogen fuel cell electric cars)

Authority (in Norwegian)	Authority (in English)	Abbre-viation	Home page
Statens vegvesen	Norwegian Public Roads Administration	SV [1)]	www.vegvesen.no
[1)] This is an abbreviation used for the purpose of this report			

In addition to the harmonized procedures for approval of hydrogen fuel cell electric cars based on EU provisions according to clause 5.1 above, Norway does also have procedures for national type-approval. Regulations, guidelines etc. can be found on the homepage of Norwegian Public Roads Administration. In Norway, the registered owners of cars must be Norwegian citizens or companies.

6.3.1 Case study – Approval of Mercedes-Benz B-Class F-CELL

In Norway a national type-approval was issued on 28 October 2010 by the Norwegian Public Roads Administration, which allowed the cars to be registered in Norway on Norwegian license plates. The application for the approval was made 3 August 2010. The approval is valid until 31 December 2014 for up to ten Daimler B-Class Fuel Cell cars, intended to be used in the H2moves Scandinavia and H2moves Oslo project. The approval was based on a German national small series approval.

As the owner of the cars was Daimler AG in Germany – not a Norwegian company or citizen as required by the regulations – an issue arose, which took several months to solve, when the cars were going to be registered. On 30 November 2010, Bertel O. Steen AS (general agent for Daimler in Norway) applied for a dispensation for the regulations. Bertel O. Steen AS received such a dispensation dated 30 March 2011 from the Norwegian Public Roads Administration. The dispensation was given based on a separate contract between Daimler AG and Bertel O. Steen AS (Norwegian company). The limited number of cars, the limited period and the use in a demonstration project were important factors for the dispensation.

According to this contract the ownership of the cars was not transferred from Daimler AG to Bertel O. Steen AS, but the responsibilities and obligations for the cars were transferred from Daimler AG to Bertel O. Steen AS. By the contract, Daimler AG gave for example Bertel O. Steen AS power of attorney to represent them in dealings with the authorities and Bertel O. Steen AS became responsible for payment of any fees.

A learning from this case is that the process of registering cars on Norwegian license plates is facilitated if the cars are owned by a Norwegian company or person with Norwegian citizenship.

6.3.2 Case study – Approval of Hyundai ix35 FCEV

In Norway a national single approval and registration for two individual cars was received on 18 November 2011 from the Norwegian Public Roads Administration, which allowed Norwegian license plates to be used for the cars.

The owner of the cars – Hyundai Motor Norway AS (Norwegian company) – applied for the approval (for unlimited time) according to a letter dated 3 November 2011 to the Norwegian Public Roads Administration. The letter was annexed with the following documents:
- EC Certificates of Conformity (for the two cars)
- Technical documentation with certificates etc. related to the hydrogen system, electric power train system and the base vehicle.

According to the application, the cars are samples from a pre-series intended for normal use and for evaluation purposes under such use.

The EC Certificates of Conformity for the cars referred to, amongst other, a whole vehicle type-approval issued 2010 for the base vehicle (with a conventional power train), which has been rebuild to a hydrogen fuel cell electric car.

The time from application to approval and registration, was in total 15 days (3-18 November). For a conventional car, it would normally take 3-5 days. In the actual case,

the officers which were supposed to handle the application, were absent from the office approx. one week. In a phone contact with the Norwegian Public Roads Administration, Hyundai Motors Norway was advised to inspect the cars at the Roads Administration's inspection body in Drammen.

During the last week the cars were inspected. More than one visit was needed at the inspection body during that week. Hyundai Motor Norway got the impression that the reason for the multiple visits were related to uncertainties by the inspection personnel on how to or what to inspect on the hydrogen fuel cell electric car. At the last visit the cars were registered, and licence plates and document were issued.

A learning from this case was that the process of achieving approval and registration for the fuel cell electric cars in Norway, took a somewhat longer time than it would take normally, for conventionally cars.

6.3.3 Case study – Approval of Th!nk City Car Hydrogen 2010

Manufacturer of the Think City Hydrogen 2010, is H2 Logic A/S in Denmark. H2 Logic modifies battery powered electric cars (Think City 306) manufactured by THINK Global AS, by reducing the battery capacity (by approx. one third) and installing fuel cells, 700 bar (70 MPa) hydrogen tanks and associate control system in the cars. This power source is complementary to the batteries and, therefore, serves as a range extender for the battery operated car.

In Norway a national type-approval was issued on 1 June 2011 by the Norwegian Public Roads Administration (SV), which allowed the car to be registered and Norwegian license plates to be used. The car is categorized M1 in the approval and Think Technology AS (a Norwegian company) is specified as holder of the approval. The approval is based on a type-approval for the base vehicle (with a battery operated power train). The approval is valid five years from the date of registration (considering the use for demonstration purposes during a limited period) and requires the first fuelling with hydrogen to be carried out by a qualified person. The approval is valid for up to maximum five cars.

The process of achieving type-approval from SV needed 5 months and included activities according to Table 5.3.3-1. During this period the electrical parts (electric power train) was assessed and tested according to ECE-R100 by a testing laboratory.

Table 6.3.3-1 Major steps in the process of achieving approval for Th!nk City Hydrogen 2010

Date/Period	Activity
2011-01-10	H2 Logic submitted application for approval to the Norwegian Public Roads Administration (SV).
2011-02-14	Two questions received from SV, concerning brakes and collision safety of the control gear.
2011-02-22--	H2 Logic request and receive complementary information from Think Global AS and the testing laboratory, concerning the questions from SV.
2011-03-15	Formal letter dated 2011-03-15 sent from SV to H2 Logic concerning questions/issues dealing with the weight and load, brakes, collision safety of the control gear and safety when charging.
April - May 2011	The testing laboratory made insulation tests of the car.
2011-05-09	H2 Logic submitted an email to SV, with answers to the questions supported by a Statement from Think Global AS. The report from the

	tests of the electrical power system is pending and will be sent when issued by the testing laboratory.
2011-05-12	Test Report was issued by the testing laboratory.
2011-05-23	According to an answer by email from SV all issues were not fully solved. However, SV is able to grant an exemption based on the received information and based on the use during a limited period to demonstrate environment friendly technology.
2011-05-23--31	One of the five cars was inspected by SV.
2011-06-01	The type-approval was issued by SV.

A learning from this case, in achieving type-approval for new cars in Norway, is that time consuming issues raised in the communication with the approval authorities can be minimized by a detailed analysis on an early stage of applicable requirements (technical as well as administrative and procedural requirements). Meetings on an early stage with the approval officers in charge, will facilitate the work to identify and clarify requirements to be met.

6.4 Denmark

The authorities responsible for regulations, type-approval and registration of cars in Denmark are specified in the following table:

Table 6.4-1 Danish authorities responsible for type-approval and registration of cars (incl. hydrogen fuel cell electric cars)

Authority (in Danish)	**Authority (in English)**	**Abbre-viation**	**Home page**
Trafikstyrelsen	The Danish Transport Authority	FSTYR [1)]	www.fstyr.dk
SKAT	SKAT		www.skat.dk
[1)] This is an abbreviation used for the purpose of this report			

In addition to the harmonized procedures for approval of hydrogen fuel cell electric cars based on EU provisions according to clause 5.1 above, Denmark does also have procedures for national approvals. Regulations, guidelines etc. can be found on homepages of the authorities.

FSTYR is the authority handling approvals for vehicles while SKAT is the authority which handles taxes (incl. VAT and customs), registration of vehicles and license plates for vehicles.

6.4.1 Case study – Approval of Th!nk City Hydrogen 2010

In Denmark a national single approval of individual cars was received in 2009 from the Danish Transport Authority (FSTYR), for six Th!ink city cars to be used for demonstrations in Copenhagen. The approval specifies the serial numbers of the cars and fuel cell systems. The battery operated cars, manufactured by Think Technology, were modified by the Danish manufacturer H2 Logic A/S to incorporate a fuel cell stack, hydrogen tank system and associated control system. This complementary hydrogen propulsion system, serves as a range extender for the battery operated car.

The achieved Danish national approval of the six rebuilt Th!nk city cars was based on:

- EC type-approval (whole vehicle certificate hold by Think Technology) of the originally battery operated car
- EC Certificate of Conformity where the original manufacturer (Think Technology) declares that that the specified individual cars are in compliance with the EC type-approval
- Technical reports from an accredited 3rd party testing agency, concerning inspection of the car with respect to the fuel cell system based on requirements according to UN-ECE Draft ECE Regulation TRANS/WP.29/GRPE/2004/03, Part II (replaced now – at the publication of this report – by the European Regulation (EC) No 79/2009)
- Information from Think Technology, concerning acceptance of increased weight of the cars

Following the national approval issued by FSTYR, the cars were inspected by Bilsyn in Denmark. Information given by FSTYR in the approval document was considered at the inspection, for example registration of supplementary technical data from the inspection. For the inspection, the following documents need to be submitted to Bilsyn:

- The approval document from FSTYR
- Certificate of conformity from the car manufacturer
- Report on measured weights (total, front axle, rear axle)
- Statement from Think Technology on allowed axle loads and total weight

Following the inspection, the cars were registered by SKAT. To be registered, the following documents need to be submitted to SKAT:

- The approval document from FSTYR
- Certificate of conformity from the car manufacturer
- Attestation of fee exemption (for hydrogen and electric cars), certificate of origin
- Insurance document
- Inspection report from Bilsyn

6.5 Summary

6.5.1 Conclusions

Well harmonized approval procedures and requirements concerning safety, are currently in force in Sweden, Norway and Denmark based on common European Regulations (EC) No 79/2009 and No 406/2010 (used together with the Framework Directive 2007/46/EC for approval of vehicles).

The actual case studies shows that the approval for hydrogen fuel cell electric cars may take more time to went through than approvals for conventional cars. However, this situation is expected to have a limited duration until approval authorities, inspection bodies and manufacturers get more experience of applying the harmonized procedures and requirements. Furthermore, these procedures and requirements have many elements in common with conventional cars and other cars such as battery powered electric vehicles and vehicles powered by other gases (e.g. bio methane and natural gas).

Learnings from introducing fuel cell electric cars on the Scandinavian market, show that difficulties with approvals may occur if the cars are not owned by a company registered in the actual country (or by a person with citizenship in the actual country).

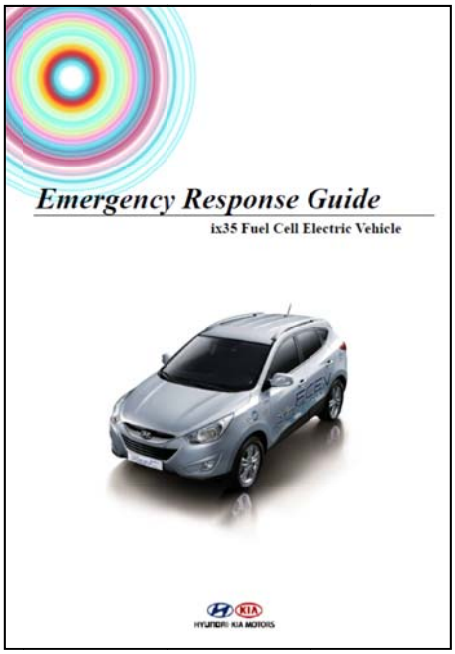
Another learning is that time consuming issues subject to communication with the approval authorities, can be minimized by a detailed analysis on an early stage of applicable requirements (technical as well as administrative and procedural requirements). Meetings on an early stage with the approval officers in charge, will also facilitate the work to identify and clarify requirements to be met.

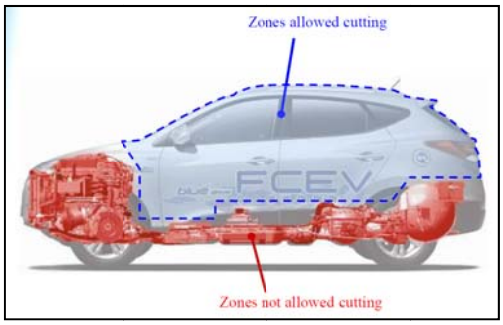
Requirements (technical as well as administrative and procedural requirements) which are easy to find and transparent on the homepages of the approval authorities - in languages which are commonly used and understood by manufacturers and suppliers located also outside the Scandinavian countries – will also facilitate the approval process.

For hydrogen, as for many other alternative fuels (natural gas, bio methane gas etc.), questions are raised from rescue personnel and rescue authorities concerning risks associated with such fuel and how to consider such risks in rescue operations where hydrogen cars are involved. The need to consider these safety aspects for rescue services is also addressed by the Council and Parliament of the European Union in the European Regulation (EC) No 79/2009 for hydrogen-powered motor vehicles, which states:

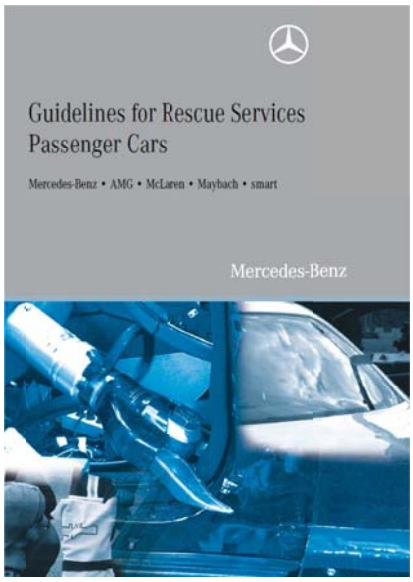
“Owing to the characteristics of the fuel, hydrogen-powered vehicles may require a specific treatment from rescue services. It is therefore necessary to lay down requirements for the clear and rapid identification of such vehicles, allowing the rescue services to be informed of the fuel stored on board the vehicle. Whilst the means of identification should be fit for that purpose it should, as far as possible, avoid being of a nature that is likely to give rise to concern among the public.”

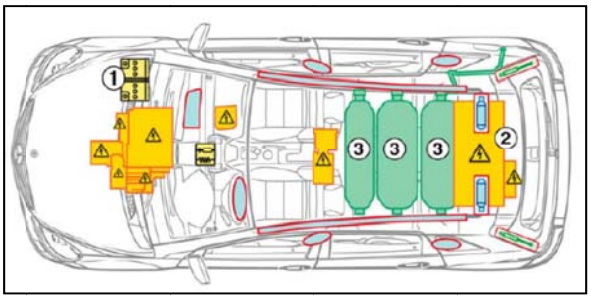
As for conventional fuels like gasoline, risks concerning fire and explosions need to be considered. In the same way as for battery powered electric cars, risks related to high voltages need to be considered. To address and satisfy these needs for rescue operations, the car manufacturers participating in the project have developed guidelines for their cars, see examples according to picture 6.5-1 and 6.5-2.





Picture 6.5-1 Extracts from Emergency Response Guide (Hyundai iX35)





Picture 6.5-2 Extract from Guidelines for Rescue Services (Mercedes Benz B-Class)

To allow a rapid and clear identification of hydrogen powered vehicles in rescue operations, an identification marking system has been standardized by the Commission Regulation No 406/2010. Hydrogen-powered cars shall be marked accordingly, see example of marking according to Picture 6.5-3.

Additionally, for the users of the cars, label(s) shall be provided close to the receptacle, showing "H2 gas" and "XX MPa" (where "XX" is the nominal working pressure for the hydrogen tank).

Picture 6.5-3 Marking for identification of a gaseous hydrogen powered car. Colours: green background, white border and white letters (border and letter, or background, shall be retro-reflective)

6.5.2 Recommendations

Based on the conclusions above, recommendations concerning approval procedures related to safety aspects – to facilitate the commercialisation of fuel cell vehicles - can be summarized as following:

- *Cars to be approved and registered, should be owned by a company registered in the actual country (or owned by a person with citizenship in the actual country)*

- *Applicants seeking approval for cars, should on an early stage seek detailed information on applicable requirements (technical as well as administrative and procedural requirements) from the approval officers in charge of handling such applications*

- *Authorities for approval and registration of cars, should ensure that information on the requirements is easily available on their home pages in commonly used languages*

Furthermore, the following is recommended concerning rescue operations:

- *Guidelines from car manufacturers for rescue operations should be easily and electronically available for rescue personnel through a common internet-based home page on national levels and on national languages, possibly also supported by adequate apps for mobiles.*

- *National authorities - with coordinating roles in Sweden, Norway and Denmark – should ensure that rescue personnel receive education and guidelines concerning hydrogen gas and fuel cell electric vehicles in general.*

Appendix A
Legislation of particular interest for hydrogen fuelling stations – safety aspects

A1 Sweden

A1.1 The Swedish Civil Contingencies Agency (MSB)
Myndigheten för samhällsskydd och beredskap

Table A1.1-1 Legislation of particular interest for hydrogen fuelling stations in Sweden

Laws, ordinances and regulations		Issued by	Comments
in Swedish	**in English** [1)]		
SFS 2010:1011 Lagen om brandfarliga och explosiva varor (LBE)	SFS 2010:1011 Law on flammable substances and explosives (LBE)	Parliament	New law from 2010-09-01 (replaces 1988:868)
SFS 2003:778 Lagen om skydd mot olyckor (LSO)	SFS 2003:778 Law on protection against accidents (LSO)	Parliament	
SFS 2010:1075 Förordning om brandfarliga och explosiva varor (FBE)	SFS 2010:1075 Ordinance on flammable substances and explosives (FBE)	Government	New ordinance from 2010-09-01 (replaces 1988:1145)
SFS 2003:789 Förordning om skydd mot olyckor (FSO)	SFS 2003:789 Ordinance on protection against accidents (FSO)	Government	
SRVFS 2004:7 Föreskrifter om explosionsfarlig miljö vid hantering av brandfarliga gaser och vätskor	SRVFS 2004:7 Regulations on explosive atmospheres when handling flammable gases and liquids	Statens räddningverk [2)]	Implements ATEX User Directive 1999/92/EC
SÄIFS 2000:4 Föreskrifter om cisterner, gasklockor, bergrum och rörledningar för brandfarlig gas	SÄIFS 2000:4 Regulations on tanks, gas holders, caverns and pipes for flammable gases	Sprängämnesinspektionen [2)]	
SÄIFS 1998:5 Tankstationer för metangasdrivna fordon	SÄIFS 1998:5 Regulations on fuelling stations for methane propelled vehicles	Sprängämnesinspektionen [2)]	This is a regulation for methane fuelling stations. In lack of corresponding regulation for hydrogen fuelling stations, applicable parts of this regulation may serve as a guideline for hydrogen fuelling stations.
MSBFS 2009:7 Föreskrift om ledningssystem för	MSBFS 2009:7 Regulations on pipelines for natural gas	MSB	

naturgas			
SÄIFS 1998:7 Föreskrifter om brandfarlig gas i lös behållare	SÄIFS 1998:7 Regulations on portable containers for flammable gases	Sprängämnesinspektionen [2)]	
SRVFS 2005:3 Föreskrifter om transportabla tryckbärande anordningar	SRVFS 2005:3 Regulations on transportable pressure equipment	Sprängämnesinspektionen [2)]	Implements TPED Directive 99/36//EC
SÄIFS 1995:3 (med ändringar enligt 1997:3) Tillstånd till hantering av brandfarliga gaser och vätskor	SÄIFS 1995:3 (with changes according to 1997:3) Regulations on permits for handling of flammable gases and fluids	Sprängämnesinspektionen [2)]	New regulations are expected to replace these in 2013
SRVFS 2003:10 Föreskrifter om skriftlig redogörelse för brandskyddet	SRVFS 2003:10 Regulations on written declarations concerning fire safety	Statens räddningverk [2)]	
SRVFS 2004:3 Allmänna råd och kommentarer om systematiskt brandskyddsarbete	SRVFS 2004:3 Recommendations on systematic fire prevention work	Statens räddningverk [2)]	
SRVFS 2004:4 Allmänna råd och kommentarer om skriftlig redogörelse för brandskyddet	SRVFS 2004:4 Recommendations on handling of hazardous activities	Statens räddningverk [2)]	

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

[2)] This authority do not exist anymore and the responsibilities of this authority have been transferred to the authority: The Swedish Civil Contingencies Agency (MSB)

Note: Laws, ordinances and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

A1.2 The Swedish National Electrical Safety Board (ELSAK)
Elsäkerhetsverket

Table A1.2-1 Legislation of particular interest for hydrogen fuelling stations in Sweden

Laws, ordinances and regulations		Issued by	Comments
in Swedish	**in English** [1)]		
SFS 1997:857 Ellagen	SFS 1997:857 The Electricity Act	Parliament	
SFS 1992:1512 Lag om elektromagnetisk kompatibilitet	SFS 1992:1512 Act concerning Electro-magnetic Compatibility	Parliament	Implements EMC Directive 2004/108/EC
SFS 2009:22 Starkströmsförordningen	SFS 2009:22 Ordinance concerning electrical heavy current Installations	Government	
SFS 1990:806 Elinstallatörsförordningen	SFS 1990:806 Electrical installation ordinance	Government	
SFS 1993:1068 Förordning om elektrisk materiel	SFS 1993:1068 Ordinance concerning electrical equipment	Government	Implements LVD Directive 2006/95/EC and ATEX Product Directive 94/9/EC
SFS 1993:1067 Förordning om elektromagnetisk kompatibilitet	SFS 1993:1067 Ordinance concerning Electromagnetic Compatibility	Government	Implements EMC Directive 2004/108/EC
ELSÄK-FS 1995:6 Elsäkerhetsverkets föreskrifter om elektriska utrustningar för explosionsfarlig miljö	ELSÄK-FS 1995:6 The Swedish National Electrical Safety Board's regulations concerning electrical equipment intended for use in potentially explosive atmospheres	ELSAK	Implements ATEX Product Directive 94/9/EC for electrical equipment
ELSÄK-FS 2000:1 Elsäkerhetsverkets föreskrifter om viss elektrisk materiel samt allmänna råd om dessa föreskrifters tillämpning	ELSÄK-FS 2000:1 The Swedish National Electrical Safety Board's regulations concerning certain electrical equipment and general advice when applying these regulations	ELSAK	Implements LVD Directive 2006/95/EC
ELSÄK-FS 2006:1 Elsäkerhetsverkets föreskrifter och allmänna råd om elsäkerhet vid arbete i yrkesmässig verksamhet	ELSÄK-FS 2006:1 The Swedish National Electrical Safety Board's regulations and general advice on electrical safety for work in professional activity	ELSAK	
ELSÄK-FS 2008:1 Elsäkerhetsverkets föreskrifter och allmänna råd om hur elektriska starkströmsanläggningar	ELSÄK-FS 2008:1 The Swedish National Electrical Safety Board's regulations regarding design and erection of	ELSAK	

ska vara utförda	electrical heavy current installations and general advice when applying these regulations		
ELSÄK-FS 2008:2 Elsäkerhetsverkets föreskrifter och allmänna råd om varselmärkning vid elektriska starkströmsanläggningar	ELSÄK-FS 2008:2 The Swedish National Electrical Safety Board's regulations regarding electrical warning hazard signs and labels of electrical heavy current installations and general advice when applying these regulations	ELSAK	
ELSÄK-FS 2008:3 Elsäkerhetsverkets föreskrifter och allmänna råd om innehavarens kontroll av elektriska starkströmsanläggningar och elektriska anordningar.	ELSÄK-FS 2008:3 The Swedish National Electrical Safety Board's regulations regarding surveillance of electrical heavy current installa-tions, electrical devices and general advice when applying these regulations	ELSAK	
ELSÄK-FS 2007:1 Elsäkerhetsverkets föreskrifter om elektromagnetisk kompatibilitet	The Swedish National Electrical Safety Board's Regulations concerning Electromagnetic Compatibility	ELSAK	Implements EMC Directive 2004/108/EC

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

Note: Laws, ordinances and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

A1.3 The Work Environment Authority (AV)
Arbetsmiljöverket

Table A1.3-1 Legislation of particular interest for hydrogen fuelling stations in Sweden

Laws, ordinances and regulations		Issued by	Comments
in Swedish	**in English** [1)]		
SFS 1977:1160 Arbetsmiljölagen (AML)	SFS 1977:1160 The Work Environment Act (AML)	Parliament	
SFS 1977:1166 Arbetsmiljöförordningen	SFS 1977:1166 Work Environment Ordinance	Government	
AFS 2006:04 Arbetsmiljöverkets föreskrifter om användning av arbetsutrustning samt allmänna råd om tillämpningen av föreskrifterna	AFS 2006:04 Provisions of the Swedish Work Environment Authority on Use of Work Equipment	AV	Implements Work equipment Directive 89/655/EEC
AFS 1997:07 Arbetarskyddsstyrelsens föreskrifter om gaser samt styrelsens allmänna råd om tillämpningen av föreskrifterna	AFS 1997:07 Regulations of the Swedish National Board of Occupational Safety and Health concerning gases, and general advice when applying these regulations	AV	Dealing with e.g. storing, loading and emptying gas, repair of gas pipes (other safety aspects than those related to flammability)
AFS 2001:4 Arbetsmiljöverkets föreskrifter om gasflaskor	AFS 2001:4 The Work Environment Authority's regulations concerning gas cylinders	AV	Dealing with e.g. storing, filling, connection and emptying of gas cylinders (bottles)
AFS 1992:18 Arbetarskyddsstyrelsens föreskrifter om motorbränslen	AFS 1992:18 Ordinance of the Swedish National Board of Occupational Safety and Health containing Provisions on Motor Fuels, together with General Recommendations on the implementation of the Provisions	AV	Dealing with e.g. maintenance and repair of pipes for motor fuel
AFS 1998:8 Arbetarskyddsstyrelsens föreskrifter om arbete i motorbranschen samt allmänna råd om tillämpningen av föreskrifterna	AFS 1998:8 Regulations of the Swedish National Board of Occupational Safety and Health on work with motors and general advice when applying these regulations	AV	Dealing with e.g. washing and service of cars.
AFS 1995:5 Arbetarskyddsstyrelsens föreskrifter om utrustningar för explosionsfarlig miljö samt styrelsens allmänna råd om tillämp-	AFS 1995:5 The Work Environment Authority's regulations concerning equipment intended for use in potentially explosive	AV	Implements ATEX Product Directive 94/9/EC for other equipment than electrical equipment

ningen av föreskrifterna	atmospheres and general advice when applying these regulations		
AFS 2008:3 Arbetsmiljöverkets föreskrifter om maskiner samt allmänna råd om tillämpningen av föreskrifterna	AFS 2008:3 The Work Environment Authority's regulations concerning machines and general advice when applying these regulations	AV	Implements Machinery Directive 2006/42/EC
AFS 1999:4 Arbetarskyddsstyrelsens föreskrifter om tryckbärande anordningar samt allmänna råd om tillämpningen av föreskrifterna	AFS 1999:4 Regulations of the Swedish National Board of Occupational Safety and Health concerning pressurized equipment, and general advice when applying these regulations	AV	Implements PED Directive 97/23/EC Applies for equipment with over pressures exceeding 0,5 bar.
AFS 2002:01 Arbetsmiljöverkets föreskrifter om användning av trycksatta anordningar samt allmänna råd om tillämpningen av föreskrifterna	AFS 2002:1 The Work Environment Authority's regulations concerning use of pressurized equipment and general advice when applying these regulations	AV	Related to AFS 2006:04 and Work equipment Directive 89/655/EEC
AFS 2005:2 Arbetsmiljöverkets föreskrifter om tillverkning av vissa behållare, rörledningar och anläggningar samt allmänna råd om tillämpningen av föreskrifterna	AFS 2005:2 Provisions of the Swedish Work Environment Authority on Manufacture of certain Vessels, Piping and Installations, together with General Recommendations on the implementation of the Provisions	AV	Applies for some of the pressurized equipment not covered by PED Directive 97/23/EC. Applies also for installations/assemblies of PED equipment (connections, pipes etc.).
AFS 2005:3 Arbetsmiljöverkets föreskrifter om besiktning av trycksatta anordningar samt allmänna råd om tillämpningen av föreskrifterna	AFS 2005:3 The Work Environment Authority's regulations concerning inspection of pressurized equipment and general advice when applying these regulations	AV	Implements partly PED Directive 97/23/EC
AFS 1993:41 (omtryckt som 1994:53) Arbetarskyddsstyrelsens föreskrifter om enkla tryckkärl samt allmänna råd om tillämpningen av föreskrifterna	AFS 1993:41 (reprinted as 1994:53) Regulations of the Swedish National Board of Occupational Safety and Health concerning simple pressurized equipment, and general advice when applying these regulations	AV	Implements SPVD Directive 87/404/EEC (replaced by 2009/105/EC) Applies for equipment with over pressures exceeding 0,5 bar, for storage of air or nitrogen.

AFS 2006:8 Arbetsmiljöverkets föreskrifter om provning med över eller undertryck och allmänna råd om tillämpningen av föreskrifterna	AFS 2006:8 Provisions of the Swedish Work Environment Authority on Testing at Over or Under Pressure	AV	Requires, amongst other, an accredited body to perform pressure tests if the test pressure exceeds 3 bar.
AFS 2008:13 Arbetsmiljöverkets föreskrifter om skyltar och signaler för hälsa och säkerhet under arbete samt allmänna råd om tillämpningen av föreskrifterna	AFS 2008:13 The Work Environment Authority's regulations concerning signs and signals for health and safety at work and general advice when applying these regulations	AV	Deals with signs and signals at work. Implements Directive 92/58/EEC.
AFS 2011:19 Arbetsmiljöverkets föreskrifter och allmänna råd om kemiska arbetsmiljörisker	AFS 2011:19 The Work Environment Authority's regulations and general advice concerning chemical risks at work	AV	Deals with chemical risks at work. Implements Directive 98/24/EC.

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

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A2 Norway

A2.1 Directorate for Civil Protection and Emergency Planning (DSB)

Direktoratet for samfunnssikkerhet og beredskap

Table A2.1-1 Legislation of particular interest for hydrogen fuelling stations in Norway

Laws and regulations		Issued by	Comments
in Norwegian	**in English** [1)]		
LOV 1929-05-24 nr 4: Lov om tilsyn med elektriske anlegg og elektrisk utstyr (el-tilsynsloven)	LOV 1929-05-24 nr 4: Act relating to the supervision of electrical installations and electrical equipment	Parliament	
LOV 2002-06-14 nr 20: Lov om vern mot brann, eksplosjon og ulykker med farlig stoff og om brannvesenets redningsoppgaver (brann- og eksplosjonsvernloven)	LOV 2002-06-14 nr 20: Act relating to the prevention of fire, explosion and accidents involving hazardous substances and the fire service	Parliament	
LOV-2008-06-27 nr 71: Lov om planlegging og byggesaksbehandling (plan- og bygningsloven)	LOV-2008-06-27 nr 71: Act relating to planning and the processing of building applications (the planning part) [Planning- and Building Act (the planning part)]	Parliament	
FOR 1996-12-06 nr 1127: Forskrift om systematisk helse-, miljø- og sikkerhetsarbeid i virksomheter (Internkontrollforskriften, HMS)	FOR 1996-12-06 nr 1127: Regulations relating to systematic health, environmental and safety activities in enterprises (Internal Control Regulations)	DSB	This is a common regulation for the following authorities: DSB, DAT, Statens strålevern, Klima- og forurensningsdirektorate t (Klif), Sosial- og helsedirektoratet and Direktoratet for naturforvaltning
FOR-2009-06-08 nr 602: Forskrift om håndtering av brannfarlig, reaksjonsfarlig og trykksatt stoff samt utstyr og anlegg som benyttes ved håndteringen	FOR-2009-06-08 nr 602: Regulation concerning handling of flammable, reactive or pressurized substances, and equipment and facilities used for handling such substances	DSB	This regulation is included in a guideline ("Veiledning…") to the regulation.
FOR 1998-11-06 nr 1060: Forskrift om elektriske lavspenningsanlegg	FOR 1998-11-06 nr 1060: Regulation concerning low voltage installations	DSB	Requirements for low voltage installations. Standards fulfilling the safety requirements are EN 60079-14 and EN 60079-17 in addition to the IEC 60364-series.
FOR-1993-12-14-1133: Forskrift om	FOR-1993-12-14-1133: Regulations relating to	DSB	Regulations requires additional training in

kvalifikasjoner for elektrofagfolk	qualification of electrical professions and trades		special fields e.g. installations in hazardous areas.
FOR 2002-11-22 nr 1323: Forskrift om registrering av virksomheter som prosjekterer, utfører og vedlikeholder elektriske anlegg	FOR 2002-11-22 nr 1323: Regulations concerning the registration of Enterprises which design, install and maintain electrical installations (frv)	DSB	Regulations requires registration for special fields e.g. installations in hazardous areas.
FOR 2008-10-31 nr 1164: Forskrift om elektrisk utstyr	FOR 2008-10-31 nr 1164: Regulation concerning electrical equipment	DSB	Implements LVD 2006/95/EC and EMC Directive 2004/108/EC
FOR 1996-12-09 nr 1242: Forskrift om utstyr og sikkerhetssystem til bruk i eksplosjonsfarlig område	FOR 1996-12-09 nr 1242: Regulation concerning equipment and protective systems for explosive environments	DSB [2)]	Implements ATEX Product Directive 94/9/EC.
FOR 2003-06-30 nr 911: Forskrift om helse og sikkerhet i eksplosjons-farlige atmosfærer	FOR 2003-06-30 nr 911: Regulation concerning health and safety related to explosive atmospheres	DSB [3)]	Implements ATEX User Directive 1999/92/EC
FOR 1999-06-09 nr 721: Forskrift om trykkpåkjent utstyr	FOR 1999-06-09 nr 721: Regulation concerning pressurized equipment	DSB	Implements PED Directive 97/23/EC
FOR 2001-06-26 nr 792: Forskrift om transportabelt trykkutstyr	FOR 2001-06-26 nr 792: Regulation concerning transportable pressurized equipment	DSB	Implements TPED Directive 99/36/EC. Work is on-going on a new regulation based on the new TPED Directive 2010/35/EU.
FOR 1994-07-07 nr 735: Forskrift om enkle trykkbeholdere	FOR 1994-07-07 nr 735: Regulation concerning simple pressurized vessels	DSB	Implements SPVD Directive 87/404/EEC (replaced by 2009/105/EC)

1) In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

2) This regulation is managed by DSB and DAT in cooperation, with DSB as coordinator. DSB is responsible for requirements related to flammable mist, vapour and gas. DAT is responsible for requirements related to combustible dust.

3) This regulation is managed by DSB and DAT in cooperation, with DAT as coordinator. DSB is responsible for requirements related to flammable mist, vapour and gas. DAT is responsible for requirements related to combustible dust.

Note: Laws and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

A2.2 The Norwegian Labor Inspection Authority (DAT)

Direktoratet for arbeidstilsynet

Table A2.2-1 Legislation of particular interest for hydrogen fuelling stations in Norway

Laws and regulations		Issued by	Comments
in Norwegian	**in English** [1)]		
LOV 2005-06-17 nr 62: Lov om arbeidsmiljø, arbeidstid og stillingsvern mv. (arbeidsmiljøloven - aml)	LOV 2005-06-17 nr 62: Act relating to working environment, working hours and employment protection, etc. (Working Environment Act)	Parliament	
LOV 1976-06-11 nr 79: Lov om kontroll med produkter og forbrukertjenester (produktkontrolloven)	LOV 1976-06-11 nr 79: Act relating to the control of products and consumer services (The Product Control Act)	Parliament	
LOV 1929-05-24 nr 4: Lov om tilsyn med elektriske anlegg og elektrisk utstyr (el-tilsynsloven)	LOV 1929-05-24 nr 4: Law regarding the supervision of electrical installations	Parliament	
LOV 2002-06-14 nr 20: Lov om vern mot brann, eksplosjon og ulykker med farlig stoff og om brannvesenets rednings-oppgaver (brann- og eksplosjonsvernloven)	LOV 2002-06-14 nr 20: Act relating to the prevention of fire, explosion and accidents involving hazardous substances and the fire service	Parliament	
FOR 1996-12-06 nr 1127: Forskrift om systematisk helse-, miljø- og sikkerhetsarbeid i virksomheter (Internkontrollforskriften, HMS)	FOR 1996-12-06 nr 1127: Regulations relating to systematic health, environmental and safety activities in enterprises	DAT	This is a common regulation for the following authorities: DSB, DAT, Statens strålevern, Klima- og forurensningsdirektorate t (Klif), Sosial- og helsedirektoratet and Direktoratet for naturforvaltning
FOR 1998-06-26 nr 608: Forskrift om bruk av arbeidsutstyr	FOR 1998-06-26 nr 608: Regulation concerning use of work equipment	DAT	Implements Work equipment Directive 89/655/EEC
FOR 2009-05-20 nr 544: Forskrift om maskiner	FOR 2009-05-20 nr 544: Regulation concerning machinery	DAT	Implements a number of directives e.g. Machinery Directive 2006/42/EC [2)]
FOR 1982-09-10 nr 1377: Forskrift om tekniske innretninger	FOR 1982-09-10 nr 1377: Regulation concerning technical facilities	DAT	For work equipment not covered by the Machinery Directive

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

[2)] DAT is responsible for implementing the Machinery Directive for industrial machines while DSB is responsible for implementing the Directive for machines in household (FOR 2009-05-20 nr 544).

Note: Laws and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

A3 Denmark

A3.1 The Danish Safety Technology Authority (SIK)
Sikkerhedsstyrelsen

Table A3.1-1 Legislation of particular interest for hydrogen fuelling stations in Denmark

Laws and regulations		Issued by	Comments
in Danish	**in English** [1)]		
LBK nr 990 af 08/12/2003 om elektriske stærk-strømsanlæg og elektrisk materiel (Stærkstrømsloven)	LBK nr 990 af 08/12/2003 Act on electrical power installations and electrical equipment (Strong Power Act)	Parliament	Implements LVD 73/23/EEC
LOV nr 989 af 08/12/2003 om autorisation af elinstallatører m.v.	LOV nr 989 af 08/12/2003 Act on Authorization of electricians, etc.	Parliament	
LOV 988 af 08/12 2003 om gasinstallationer og installationer i forbindelse med vand- og afløbsledninger	LOV 988 af 08/12 2003 Act on gas installations and installations for water and sewers		
BEK nr 12502 af 01/07/2001 Stærkstrømsbekendt-gørelsen, afsnit 6 Elektriske installationer		SIK	Requirements for low voltage installations
BEK nr 797 af 30/08/1994 Bekendtgørelse om ikrafttræden af EF-direktiv om tilnærmelse af medlemsstaternes lovgivning om elektrisk materiel bestemt til anvendelse inden for visse spændings-grænser…	BEK nr 797 af 30/08/1994 Order on the entry into force of EU Directive on the approximation of laws relating to electrical equipment designed for use within certain voltage limits...	SIK	Implements LVD 73/23/EEC (replaced by 2006/95/EC)
BEK nr 612 af 25/06 2008 Bekendtgørelse om indretning af tekniske hjælpemidler	BEK nr 612 af 25/06 2008 Order on the design of technical aids	SIK	Implements e.g. Machinery Directive 2006/42/EC
BEK nr 696 af 18/08 1995 Bekendtgørelse om indretning af tekniske hjælpemidler til anvendelse i eksplosionsfarlig atmosfære	BEK nr 697 af 18/08 1995 Order on the design of technical aids for use in potentially explosive atmospheres	SIK	Implements ATEX Product Directive 94/9/EC for other equipment than electrical equipment
BEK nr 697 af 18/08 1995 Bekendtgørelse för elektrisk materiel og elektriske sikringssystemer til anvendelse i	BEK nr 697 af 18/08 1995 Order for electrical equipment and electrical systems intended for use in potentially	SIK	Implements ATEX Product Directive 94/9/EC for electrical equipment

eksplosionsfarlig atmosfære	explosive atmospheres		

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

Note: Laws and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

A3.2 The Danish Working Environment Authority (AT)
Arbejdstilsynet

Table A3.2-1 Legislation of particular interest for hydrogen fuelling stations in Denmark

Laws and regulations		Issued by	Comments
in Danish	**in English** [1)]		
LBK nr 1072 af 7/9/2010 Bekendtgørelse af lov om arbejdsmiljø (Arbejdsmiljøloven)	LBK nr 1072 af 7/9/2010 Act on OSH (Working Environment Act)	Parliament	
BEK nr 1109 af 15/12/1992 Bekendtgørelse om anvendelse af tekniske hjælpemidler	BEK nr 1109 af 15/12/1992 Order on the use of technical aids	AT	Implements Work equipment Directive 89/655/EEC
BEK nr 612 af 25/06/2008 Bekendtgørelse om indretning af tekniske hjælpemidler	BEK nr 612 af 25/06/2008 Order on the design of technical aids	AT	Implements Machinery Directive 2006/42/EC
BEK nr 696 af 18/08/1995 Bekendtgørelse om indretning af tekniske hjælpemidler til anvendelse i eksplosionsfarlig atmosfære	BEK nr 696 af 18/08/1995 Order on the design of technical aids for use in potentially explosive atmospheres	AT	Implements ATEX product Directive 94/9/EC for technical aids
BEK nr 478 af 10/06/2003 Bekendtgørelse om arbejde i forbindelse med eksplosiv atmosfære	BEK nr 478 af 10/06/2003 Order on the work related to the explosive atmosphere	AT	Implements ATEX User Directive 1999/92/EC
BEK nr 100 af 31/01/2007 Bekendtgørelse om anvendelse af trykbærende udstyr	BEK nr 100 af 31/01/2007 Order on the use of pressure equipment	AT	Applies for the use of pressure equipment with over pressures exceeding 0,5 bar.
BEK nr 564 af 01/07/1997 Bekendtgørelse om visse EF-direktiver om trykbeholdere	BEK nr 564 af 01/07/1997 Order on certain EU Directives for pressure vessels	AT	Implements Directive 76/767/EEC (pressure vessels)
BEK nr 743 af 23/09/1999 Bekendtgørelse om indretning af trykbærende udstyr	BEK nr 743 af 23/09/1999 Order on the design of pressure equipment	AT	Implements PED Directive 97/23/EC
BEK nr 99 af 31/01/2007 Bekendtgørelse om indretning, ombygning og reparation af trykbærende udstyr	BEK nr 99 af 31/01/2007 Order on the design, rebuilt and repair of pressure equipment	AT	
BEK nr 289 af 24/04/2001 Bekendtgørelse om transportabelt trykbærende udstyr	BEK nr 289 af 24/04/2001 Order on transportable pressure equipment	AT	Implements TPED Directive 99/36//EC
BEK nr 565 af 24/06/1994	BEK nr 565 af	AT	Implements SPVD

Bekendtgørelse om simple trykbeholdere	24/06/1994 Order on simple pressure vessels		Directive 87/404/EEC (replaced by 2009/105/EC) Applies for equipment with over pressures exceeding 0,5 bar, for storage of air or nitrogen.

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

Note: Laws and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

A3.3 The Danish Emergency Management Agency (DEMA)
Beredskabsstyrelsen

Table A3.3-1 Legislation of particular interest for hydrogen fuelling stations in Denmark

Laws and regulations		Issued by	Comments
in Danish	**in English** [1)]		
LBK nr 660 af 10/06/2009 Bekendtgørelse af beredskabsloven	LBK nr 660 af 10/06/2009 Notice of Emergency Management Act	Parliament	
BEK nr 1444 af 15/12/2010 Bekendtgørelse om tekniske forskrifter for gasser	BEK nr 1444 af 15/12/2010 Ordinance on Technical Requirements for gases	DEMA	Applies for pressure containers in hydrogen stations etc. with over pressures exceeding 0,5 bar

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

Note: Laws and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

A3.4 Danish Business Authority (DBA) [2)]
Erhvervsstyrelsen

Table A3.4-1 Legislation of particular interest for hydrogen fuelling stations in Denmark

Laws and regulations (in Danish)	Laws and regulations (in English) [1)]	Issued by	Comments
LBK nr 823 af 03/07/2007 Bekendtgørelse af lov om radio- og teleterminaludstyr og elektromagnetiske forhold	LBK nr 823 af 03/07/2007 Law on Radio and Telecommunications Terminal Equipment and Electromagnetic Matters	Parliament	
BEK nr 27 af 10/01/2007 Bekendtgørelse om radio- og teleterminaludstyr og elektromagnetiske forhold	BEK nr 27 af 10/01/2007 Order on Radio and Telecommunications Terminal Equipment and Electromagnetic Matters	DBA [2)]	

[1)] In lack of information on official translations of some titles, some of the titles have been translated for this report only, and shall therefore not be considered as official translations recognized by the issuing organization.

[2)] The former authority National IT and Telecom Agency (ITST) which was responsible for regulations etc. related to radio and telecommunications terminal equipment and EMC Directive 2004/108/EC) has ceased to exist.

Note: Laws and regulations specified above are subject to reprints and amendments after they have been issued. Such reprints and amendments are not specified here. Normally they can be found on the home pages of the responsible authorities. Consolidated versions including amendments may also be found there.

Appendix B
Guidelines for applicants seeking permit to handle flammable substances, issued by MSB, Sweden

Permit for handling flammable substances

1 General

Applications for permits for handling flammable substances shall be submitted to the municipality (local authority) where the handling will take place. The aim is that the local authority must ensure that they can be handled in a safe manner in accordance with legislative requirements. To enable a correct assessment the application must contain sufficient information. It may help if the applicant consults with the local authority before the permit application is submitted.

There are exceptions to the permit requirement for handling small quantities of flammable gases and liquids for certain types of facilities. These are presented in the regulations on permits for handling of flammable gases and fluids, SÄIFS 1995:3. A permit must, however, include all handling of flammable substances which takes place at the facility.

After examination by the local authority of the received documentation and after determining that the proposed facility meets the applicable regulations, the applicant will receive a permit for the handling. The applicant can then begin construction and/or installation of the facility.

When the facility is completed, it is usually inspected by the local authority before it can be put into operation, i.e. before the flammable substances are taken into the facility. This is an on-site inspection of the safety of the facility. If the facility meets the requirements, the municipality decides that the facility may be taken into operation.

The permit application is usually done on a special form provided by the local authority. The following points show what the local authority usually may need for processing an application.

The following shall apply mutatis mutandis for flammable liquids, flammable gas and fire reactive products.

2 General information

• *Property name and address* of the building where the handling will take place.
• *Name of applicant* (legal or natural person), *address*, *phone number*, and *organization* or *personal* registration number.
• *Information about the manager and instructions from the permit holder* (the instructions can wait to the inspection, seesection "9 Inspection").
• *Signature* of the authorized signatory.

3 Description of the operation

• Describe the handling, i.e. how flammable substances shall be handled and stored e.g. storage tank, storage of loose container, retail outlets, spray painting, manufacturing etc.
• Compilation of all flammable substances to be handled i.e. flammable liquid, flammable gas and fire reactive products (chemical name or trade name). For flammable liquid, the *liquid class* shall be specified: 1, 2a, 2b, or 3[1)].

[1)] Flammable Liquid Class 1: flash point (fp) < 21 °C, Class 2a: 21 < fp < 30 °C, class 2b: 30 °C < fp < 55 °C , Class 3: 55 °C < fp < 100 °C (SRVFS 2005:10).

• Quantity (stated in liters) for each type of substance, specify the maximum quantity (on each occasion) which can be handled.

4 Description of the facility

• A dimensioned *site plan* that shows location of buildings, tanks, open bins, loading and unloading areas, roads, parking lots etc. Also surrounding buildings, roads, warehouses, factories etc. should be stated. Protective and safety distance must be specified. The area's topography should also be described.

• *Drawings of buildings and facilities* where flammable substances are handled. The following should appear:
- its external appearance (the facade drawing),
- spaces where flammable substances are handled,
- details of escape routes, fire compartmentation, fire resistance ratings etc.,
- for tanks for flammable liquids in building: type of liquid and volume of each space (also flammable refrigerants and refrigerant shall be specified), for loose containers the total volume for each space, andtype of liquide and class shall be specified
- area with a tank for flammable gas, pump, vaporizers, safety valves etc.,
- for loose gas containers, the total volume shall be specified for each space and type of gas,
- ventilation design with information on the location and supply and exhaust air terminal device, air circulation, if any. Pressure conditions.

For larger or more complicated installations, the following additional information can appear:
- *sprinkled* surfaces,
- *fire smoke ventilation*, positioning,
- *fire alerted* areas,
- *embankment*, the embankment provided volume, construction materials and drainage ability (for certain flammable liquids),
- on *tank maps*, in addition to cistern geographical location shall also volume, temperature, fire resistance ratings, pressure and safety (overfill protection, pressure - vacuum valve, relief valve, burst disc, safety glasses, etc.) appear,
- in the drawings *piping* should appear in large between tanks and process facilities and within the process facility, the main shut-off valves should be marked;
- *flow chart* should show the flow, temperature, pressure and direction in the piping between the tanks and the process facility and in the process facility. The flow chart should also show pipe diameters, pressure reducing valves, control functions, bypasses, shutoff valves and the like.

5 Risk Assessment

• *Investigation of fire and explosion hazards*
A risk assessment of the facility shall be made to identify the risks of fire and explosion and the damage caused by such fire and explosions. A risk assessment should answer the following questions:
- which accident or near-accident scenarios can occur?
- which consequences can such accident or near-accident cause?
- what is the probability that they will occur?
- what measures should be taken to reduce the likelihood?

• *Documentation of the risks of explosive atmospheres*
The documentation shall be the basis for selection, installation and use of electrical equipment and other sources of ignition.

MSB regulations on explosive atmospheres when handling flammable gases and liquids, SRVFS 2004:7, and associated handbook shows what explosion protection documentation must include. The documentation shall include an assessment of the consequences of ignition of the explosive atmosphere and instructions for work in explosive atmospheres. An assessment of each hazardous area where flammable vapors or gases may occur, called a classification plan, shall be established. Within these hazardous areas, or classified areas, only explosion protected electrical and mechanical equipment shall occur. The classification can be carried out according to the Swedish Electrotechnical Commission SEK Handbook 426 "Classification of hazardous areas." A classification plan shows, usually on drawings, areas where flammable vapors or gases may occur during normal operation such that risk of explosion exists.

6 Operating and maintenance instructions

(Can be showed at the inspection of the facility.)
Aggregated operating and maintenance instructions, and instructions for commissioning and de-commissioning of the facility. They shall be in Swedish. Instructions for handling problems should also be available.

7 Certification/inspection of electrical installations, tanks, piping

At the construction of a new facility for flammable liquids, the contractor certify that the facility is technically done and mounted so that it meets the applicable regulations. Certificate of inspection of the tank and piping shall be provided. (See MSB:s regulations on tanks and pipelines for flammable fluids (MSBFS 2011:8)).

Installation inspection of accredited inspection body shall be performed on pressurized vessels (e.g. LPG tank) and larger pressurized piping for flammable gas. See the Work Environment Authority regulations on inspection of pressurized equipment, AFS 2005:3. Other vessels and piping for flammable gas shall be tested for leaks. Such verification shall be reported in protocols.

An electrical inspection conducted by a competent inspector, shall demonstrate that the electrical equipment within the hazardous areas is of correct design and installed properly. The inspector shall have knowledge of the ATEX Directives and installation of Ex-equipment.

8 Notification of manager/person

For all handling of flammable substances which require permits, there should be one or more managers/persons appointed. This is the person who under the permit holder's responsibility acts so that the handling is in accordance with the applicable provisions and within the permit. The manager/person shall be well versed in the risks related to the handling, good knowledge of the flammable substances handled and applicable provisions. This manager/person should have undergone some form of educations for such managers/persons.

9 Inspection

At inspection, it is verified that the facility has been built in accordance with the information stated in the application and that it meets applicable requirements.

At the inspection, headlines and items specified in the text above are checked. Additionally, warning and prohibition signs and that pipelines are marked according to the provisions, are checked.

Below are the signs that are required where flammable liquid and gas is handled (a), where the classified area is (b), oxidizing products and certain organic peroxides (c), and the marking of piping for flammable substances, in this example, the LPG (d) and gasoline (e).

a) Flammable products

a) Prohibition on fire

b) Area there hazardous area may occur

c) Fire Reactive goods

d) Identification of pipeline

e) Identification of pipeline

10 Regulations

Examples of regulations for flammable liquids and gases.

- Permit for handling flammable gases and liquids, SÄIFS 1995:3 (amended by 1997:3).
- Potentially explosive atmospheres when handling flammable gases and liquids, SRVFS 2004:7.
- Prohibition signs, warning signs, AFS 2008:13
- Chemical risks at work AFS 2011:19.

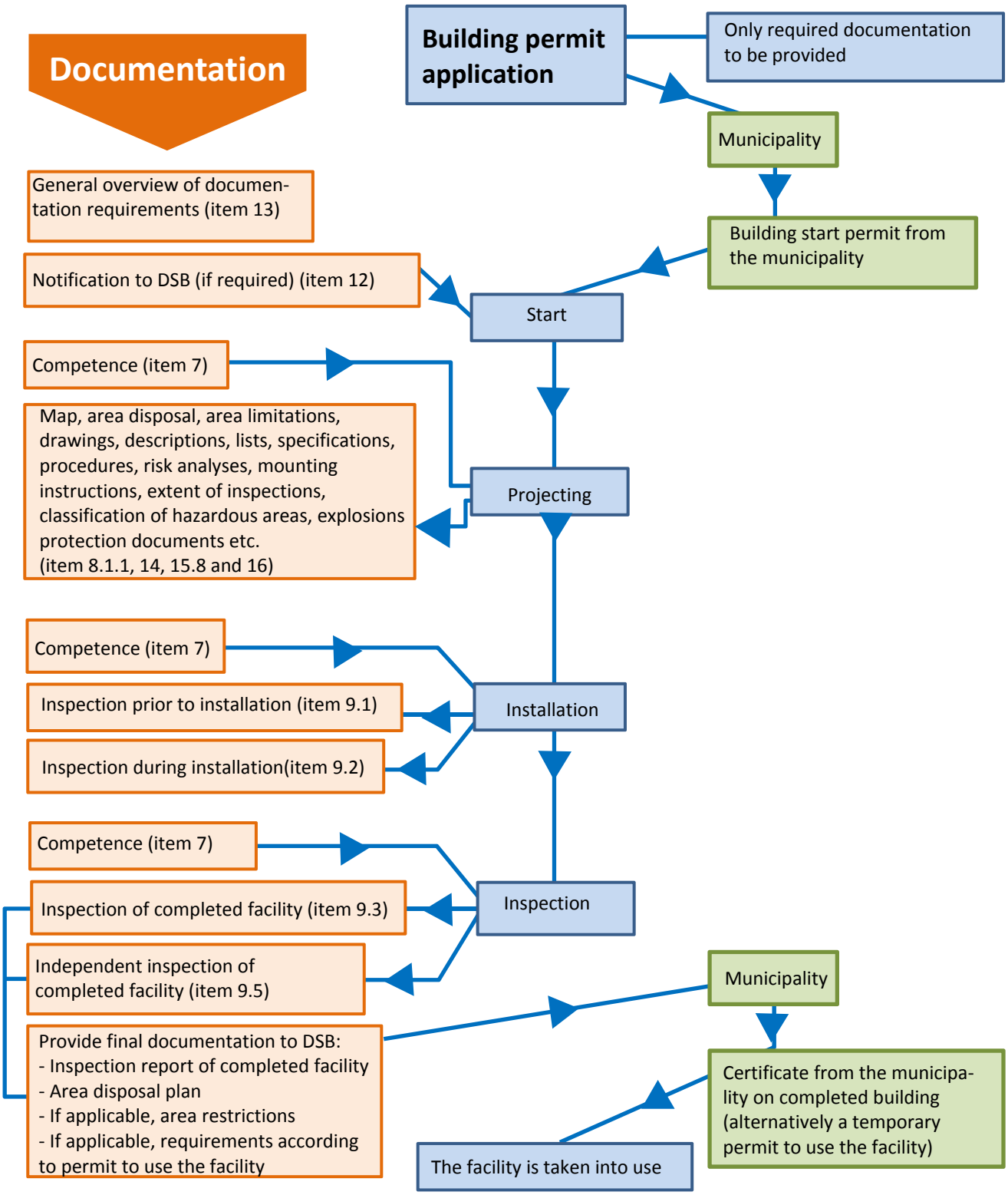
Flammable liquids:
- Flammable gases and liquids at retail outlets, SÄIFS 1996:2
- Tanks, pipelines for flammable liquids, MSBFS 2011:8.
- Handling of flammable liquids, SÄIFS 2000:2.

Flammable gas:
- Tanks, gas holders, caverns, pipes for flammable gases, SÄIFS 2000:4.
- Portable containers for flammable gases, SÄIFS 1998:7.
- Natural gas, MSBFS 2009:7.
- Fuelling stations for methane powered vehicles, SÄIFS 1998:5.

Fire reactive products
- Handling of flammable cinema film, SÄIFS 1989:4.
- Handling of ammonium nitrate, SÄIFS 1995:6.
- Handling of organic peroxides, SÄIFS 1996:4.
- Handling of hydrogen peroxide SÄIFS 1999:2.
- Handling of products containing weakly nitrated nitrocellulose SÄIFS 1989:5.

All regulations are available for download at: http://www.msb.se

Appendix C
Procedure related to Planning and Building Act according to guidelines issued by DSB, Norway



Note: The flow chart above, replicates the flow chart according to Appendix 1 in the ”Guideline concerning the use of dangerous substances, Part 1 Facilities which consumes liquid and gaseous fuels” issued by DSB. Items referred to above, are items according to this Guideline.

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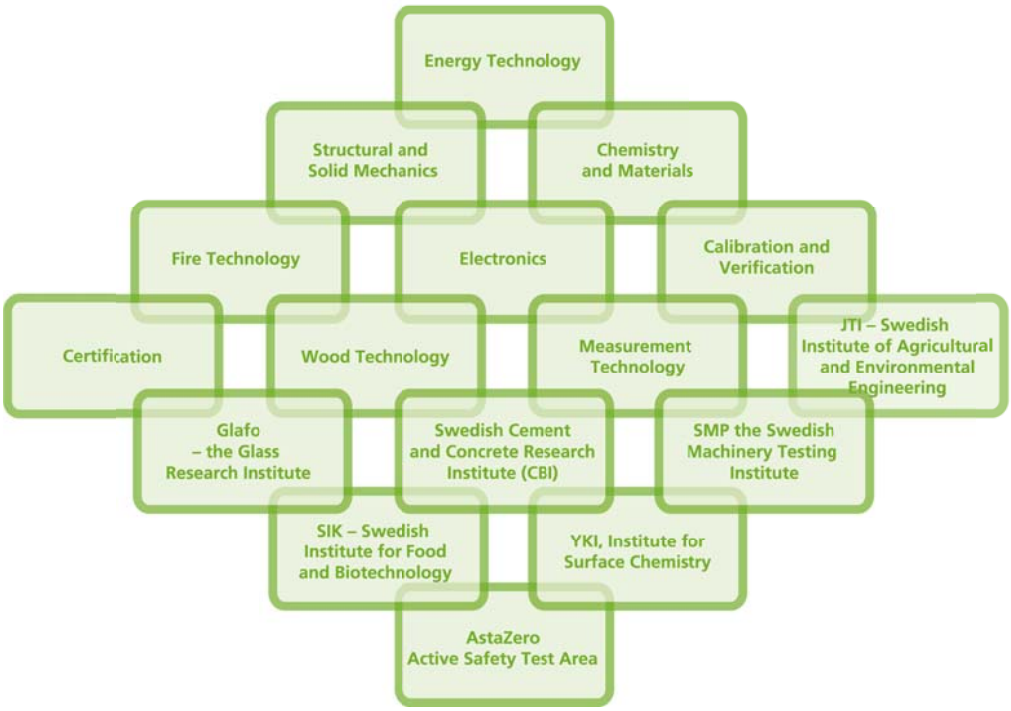

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