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

Peter Bremer and Thomas Berg

**Intermediate report**
H2moves Scandinavia and H2moves Oslo

SP Technical Research Institute of Sweden



Electronics

SP Report 2010:82

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

Peter Bremer and Thomas Berg



**Intermediate report**
H2moves Scandinavia and H2moves Oslo

# Abstract

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

This report is an intermediate report (indicated by “DRAFT” on the pages) on an ongoing study of certification and approval procedures in Sweden, Norway and Denmark, for gaseous hydrogen fuelling stations and hydrogen fuel cell cars. The report describes results from an initial phase of a three years study, lasting until the end of 2012.

The initial 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 cars. In a later phase recommendations will be considered for the approval procedures, with the aim to facilitate the commercialization of fuel cell cars across Scandinavia.

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

**SP Sveriges Tekniska Forskningsinstitut**
SP Technical Research Institute of Sweden

SP Report 2010:82
ISBN 978-91-86622-24-4
ISSN 0284-5172
Borås 2010

# Contents

# Preface

This report is an intermediate report (indicated by “DRAFT” on the pages) on an ongoing study of certification and approval procedures in Sweden, Norway and Denmark for gaseous hydrogen fuelling stations and hydrogen fuel cell 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 D2.2 in WP2. It covers studies from an initial phase of a three years study, lasting until the end of 2012.

The aim of the study is to facilitate commercialization of hydrogen fuel cell cars in Scandinavia, the availability of hydrogen fuelling stations being an important prerequisite for this. The initial phase of 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.

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 | |
| LBST, Ludwig-Bölkow-Systemtechnik GmbH, Germany | X | X |
| SINTEF, Norway | | X |
| SP Technical Research Institute of Sweden | X | X |
| TÜV SÜD Industry Services, Germany | X | X |

This project is financed by the partners and by funds from the European Commission under FCH-JU-2008-1 Grant Agreement Number 245101, and from Transnova in Norway under the contract no. 602691. Contributions by H2 Logic A/S are supported also by Danish national funds from the EUDP program.

The authors wish to thank the project partners, authority representatives, HyNor representatives and other experts involved in the task and in the reviews of this intermediate report and parts thereof, for their valuable contributions. SP is grateful to the consortium for allowing the publication of this report in the form of a SP Report.

# Summary

This report is related to initial studies of certification and approval procedures in Sweden, Norway and Denmark for hydrogen fuelling stations and hydrogen fuel cell 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.

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

As the report is limited to results from an initial phase of the three years study, it shall be considered as a preliminary and living document, subject to findings and results of further studies until the end of 2012.

Currently, harmonized EU rules related to safety requirements and conformity procedures for hydrogen fuelling stations, are not developed as much as for hydrogen fuel cell 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 contributes to a non-transparent and complex situation for the establishment of an infrastructure with hydrogen stations in Scandinavia.

In a later phase recommendations will be considered for the approval procedures, with the aim to facilitate the commercialization of fuel cell cars across Scandinavia.

# 1 Introduction

This report is an intermediate report (indicated by “DRAFT” on the pages) on an ongoing 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 cars. The report covers studies from an initial phase of a three years study, lasting until the end of 2012. The aim of the study is to facilitate commercialization of hydrogen fuel cell cars, the availability of hydrogen fuelling stations being an important prerequisite for this. The initial phase of the study is focused on identification of legislative actors and legislation which regulates certification and approval procedures in Scandinavia.

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

For hydrogen fuel cell cars, the study is focused on certification and approval aspects related to the use of gaseous hydrogen and fuel cell technology intended 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 propelled fuel cell 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 therefore 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 (now 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 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).

As the report is limited to results from an initial phase of the three years study, it shall be considered as a preliminary and living document, subject to findings and results of further studies until the end of 2012.

Currently, harmonized EU rules related to safety requirements and conformity procedures for hydrogen fuelling stations, are not developed as much as for hydrogen fuel cell vehicles. Therefore, the study is focused on hydrogen fuelling stations. Each member state is responsible for establishing its own safety rules, for safety aspects not regulated

by EU or regulated by EU by minimum requirements only. For hydrogen fuel cell cars, a significant step has been made towards harmonizing of the rules, by the publication of the European Regulation (EC) No 79/2009 for hydrogen-powered motor vehicles in 2010.

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

- regulations issued by the European Commission
- 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 (laws, ordinances and regulation).

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.

The national legislation for hydrogen stations and hydrogen fuel cell 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, 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

Acronyms and abbreviations according to the following table are used in this report:

**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<br>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) |
| H2mS | H2moves Scandinavia |
| H2mO | H2moves Oslo |
| 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

Terms according to the following table, are used in this report:

**Harmonized standard**
European standard issued by CEN or CENELEC according to a mandate from the European Commission and published by the Commission in the European Official Journal as a standard intended to support EU Directives.

## Hydrogen fuelling station

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

In this report the term “hydrogen fuelling station” has been used, based on the international Technical Specification ISO/TS 20100:2008 (Gaseous hydrogen – Fuelling stations) where this term is used.

As a short form of “hydrogen fuelling station”, also the term “hydrogen stations” is used 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 car

In this report the term “hydrogen fuel cell car” has been used. For the purpose of this report, this term shall be understood as “gaseous hydrogen fuel cell car“.

# 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 from 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. The establishment of hydrogen station, can therefore be a complicated process for operators not familiar with the national provisions. Lack of experience and lack of specific regulations and guidelines for hydrogen stations, do also contribute to the complexity and causes uncertainties.

To facilitate commercialization of hydrogen fuel cell 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.

### 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 have requirements on 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)

- *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

#### 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 determined by the Parliament
- Ordinances determined by the Government
- Regulations determined 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 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). Laws and ordinances can be found on www2.notisum.com. From this place, there are also links to authorities and to all municipalities (where local provisions applicable for the municipalities can be found).

Regulations, guidelines etc can be found on homepages of the concerned 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 1987:10 (Plan- och bygglagen), which include requirements concerning procedures, responsibilities and control related to building permits. This law will be replaced on 2011-05-02 by SFS 2010:900.

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<br>- SPVD 2009/105/EC<br>- Machinery Directive 2006/42/EC<br>- ATEX Product Directive 94/9/EC |
| The Swedish National Electrical Safety Board (ELSAK) | - LVD 2006/95/EC<br>- EMC Directive 2004/108/EC<br>- ATEX Product Directive 94/9/EC |
| The Swedish Civil Contingencies Agency (MSB) | - TPED 99/36/EC and 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 standards can be found on EU homepages for 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 as part of the regulation)
- Guidelines published by authorities, trade associations or other organizations
- Standards or handbooks (other than European standards) issued by Swedish standardization organizations
- Additional national information added in Swedish standards based on 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<br>Anvisningar för tankstationer för metangasdrivna fordon | TSA 2010<br>Guidelines for fuelling stations for vehicles using methane fuel | This guideline intends to address all applicable legislative requirements for stations providing methane fuel (natural gas or biogas). 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 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 issued by the Statens räddningsverk [1)]) |
| [1)] This authority does not exist anymore and the responsibilities of this authority have been transferred to the Swedish Civil Contingencies Agency (MSB) | | |

## 3.2.2 Approval procedures

### 3.2.2.1 Buildings and installations

This section deals with approval procedures for buildings and installations.

In cities involved in fuel cell projects, preliminary rules have usually been established to allow local approval of the projects. Such provisional rules are normally based on experiences and rules for vehicles using gas based on methane as vehicle fuel (natural gas or biogas).

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.

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

**Table 3.2.2.1-1** Principle steps for approval of a hydrogen fuelling station in Sweden

| Step | Activity |
|---|---|
| 1 | Planning and design of the hydrogen fuelling station.<br>Consultation with the local building and fire authorities.<br>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.<br>b) A written application for handling flammable gas is submitted to the local building authority (municipality)[1]. The application shall include certain information and documents, and be signed by the operator of the hydrogen fuelling station. |
| 3 | If the application for handling a flammable gas shows compliance with the legislation, the applicant receives a written permit from the local authority. |
| 4 | The station is build up.<br>The local fire authorities shall be notified in writing, about appointed person and deputy responsible for 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).<br>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;<br>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)<br>b) Inspection of the electrical installations, by a competent inspector e.g. an inspector authorized by Elektriska Nämnden [2]<br>c) Inspection by the local authority, with respect to handling a flammable gas (incl. verification that the inspections above have been passed) [3]<br>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.<br>The local authority for building permit issues a final receipt. |

[1] 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.

[2] "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.

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

**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 50 ton, notification to the local authorities is required (related to 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 the manufacturing of products.

CE-marked equipment in hydrogen fuelling stations shall therefore not be subject to 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.

Products subject to market surveillance by relevant authorities may be tested and assessed as determined by the relevant authority.

## 3.3 Norway

### 3.3.1 Legislative requirements

The Norwegian legislation comprises of:
- Laws determined by the Parliament
- Regulations determined 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 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. Laws and regulations can be found on www.lovdata.no. Regulations, guidelines etc can be found on homepages of the concerned 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 |
| Statens Bygnings-tekniske Etat | National Office of Building Technology and Administration | BE [2)] | www.be.no |
| Kommune | Municipality (local authorities) | | |

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

National Office of Building Technology and Administration (BE) 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<br>- SPVD 2009/105/EC<br>- EMC Directive 2004/108/EC<br>- PED 97/23/EC<br>- TPED 2010/35/EU<br>- ATEX Product Directive 94/9/EC [1)]<br>- Machinery Directive 2006/42/EC |
| The Norwegian Labor Inspection Authority (DAT) | - ATEX Product Directive 94/9/EC [1)]<br>- Machinery Directive 2006/42/EC |
| National Office of Building Technology and Administration (BE) | - 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. | |

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 standards can be found on EU homepages for 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 or handbooks (other than European standards) issued by Norwegian standardization organizations
- Additional national information added in Norwegian standards based on 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 regulations concerning handling dangerous substances e.g. flammable gases. It is issued by DSB. |
| Temaveiledning om bruk av farlig stoff<br>Del 1 Forbruksanlegg for flytende og gassformig brensle | Guideline concerning the use of dangerous substances<br>Part 1 User facilities for liquid and gaseous fuels | This guideline contains, amongst other, information that cars driven by gas, are not allowed to park in parking houses located more than 1 m below ground, if the parking house is part of other buildings. |
| Temaveiledning om gassanlegg | Guideline concerning gas facilities | This is a guideline to a regulation which is replaced by regulation 8. Juni 2009 (concerning handling of flammable…). It is issued by DSB. |
| Temaveiledning om prosesssanlegg | Guideline concerning process facilities | This is a guideline to a regulation which is replaced by regulation 8. Juni 2009 (concerning handling of flammable…). It is issued by DSB. |
| Veiledning til forskrift om trykkpåkjent utstyr | Guideline to regulation concerning pressurized equipment | This is a guideline to regulation 9. Juni 1999 concerning pressurized equipment. It is issued by DSB. |

## 3.3.2 Approval procedures

### 3.3.2.1 Buildings and installations

This section deals with approval procedures for buildings and installations.

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 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.

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.

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. This shall be delivered 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 regulation FOR-2009-06-08 No. 602 related to handling of flammable substances requires, amongst other, documented plans for emergency preparedness and response, risk assessment (incl. consideration of any safety restrictions for surrounding areas) and a third party inspection of the facility. The inspection shall be made with respect to requirements according to the regulation, and the inspection body shall be accredited by Norsk Akkreditering (NA). However, during a transitional period until 1 January 2012, the inspection body may alternatively be a non-accredited but a competent body. Further information on arrangements for the transitional period e.g. applications for accreditation and prequalification, can be found on DSB's and NA's homepages.

#### 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 manufacturing of products.

CE-marked equipment in hydrogen fuelling stations shall therefore not be subject to 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.

Products subject to market surveillance by relevant authorities may be tested and assessed as determined by the relevant authority.

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

In addition to the study of certification and approval procedures for hydrogen stations and hydrogen fuel cell cars, a limited study has been made regarding possible regulatory restrictions in Norway for indoor parking of hydrogen fuel cell cars, as these cars are gas propelled. The term "parking room", used here, includes all kinds of indoor parking rooms for cars (including multistory 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 User facilities for liquid and gaseous fuels (Table 3.3.1-3 above), the following additional information can be found (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."***

According to information received from DSB in December 2010, this information in the Guidelines is not fully agreed and a removal of the text is under consideration. This is currently subject to an investigation by the Norwegian Ministry of Justice.

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.

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).

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 3.3.3-1** 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** 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) | **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 determined by the Parliament
- Regulations determined 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 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. Laws and regulations can be found on www.retsinformation.dk. Regulations, guidelines etc. can be found on homepages of the concerned 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.at.dk |
| Beredskabsstyrel-sen | The Danish Emergency Management Agency (DEMA) | BRS [1)] or DEMA | www.brs.dk |
| Erhvervs- og Byggestyrelsen | Danish Enterprise and Construction Authority | EBST [1)] | www.ebst.dk |
| IT- og Telestyrelsen | National IT and Telecom Agency | ITST [1)] | www.itst.dk |
| Kommune | Municipality (local authorities) | | |

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

Danish Enterprise and Construction Authority (EBST) 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<br>- ATEX Product Directive 94/9/EC |
| The Danish Working Environment (AT) | - ATEX Product Directive 94/9/EC<br>- Machinery Directive 2006/42/EC<br>- PED 97/23/EC<br>- SPVD 2009/105/EC<br>- TPED 99/36/EC and 2010/35/EU |
| National IT and Telecom Agency (ITST) | - EMC Directive 2004/108/EC |
| Danish Enterprise and Construction Authority (EBST) | - CPD 89/106/EEC |

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 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 or handbooks (other than European standards) issued by Danish standardization organizations
- Additional national information added in Danish standards based on European Standards (EN)

## 3.4.2 Approval procedures

### 3.4.2.1 Buildings and installations

This section deals with approval procedures for buildings and installations.

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 specifies the amount of flammable gases which require a permit from the local authorities (municipality) and from DEMA, respectively.

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 an 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

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

CE-marked equipment in hydrogen fuelling stations shall therefore not be subject to 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.

Products subject to market surveillance by relevant authorities may be tested and assessed as determined by the relevant authority.

## 3.5 Discussion

The procedure for permit to operate with flammable gases (hydrogen) is different for the three countries. In Sweden and Denmark the operators need to apply for such a permit at the local authorities (municipality). In Norway, the operators need only 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 inspection body to verify compliance with requirements in the regulation. 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. In all three countries, a building permit is required from the local building authorities in the actual municipality.

Experiences from Denmark have shown that meetings 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 fuelling stations, in such meetings, may facilitate the process further.

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 providing minimum requirements, and may therefore differ between the countries. Even with the same regulatory requirements, difficulties may arise due to different practices or interpretations of requirements in such regulations or supporting standards.

Ways forward to facilitate the commercialization of hydrogen fuel cell cars, by facilitating the establishment of hydrogen fuelling stations, may include, in a short term:

- Means for operators to identify relevant legislative actors, legislation and approval requirements for hydrogen stations in the country (e.g. a national guideline for operators, developed by stakeholders in the country including relevant authorities)
- Means for relevant authorities in the country to handle approval and permits effectively (e.g. an internal guideline/checklist for authorities)
- Means and tasks for the concerned authorities in the country, to commonly develop and provide a collated information on legislative and approval requirements (e.g. a common guideline for operators, developed by the concerned authorities)

In a longer term, ways forward may include means and tasks for relevant authoirities in Sweden, Norway and Denmark, to allow for closer cooperation in order to eliminate national differences in legislative requirements and approval procedures, and to develop common Scandinavian guidelines. By harmonizing such non EU-regulated legislation in Scandinavia, applicable for hydrogen stations, Scandinavia could serve as a pilot for Europe in demonstrating the way forward for EU to harmonize corresponding provisions at European level, to facilitate the introduction of hydrogen technology for transportation.

Another important element is the availability of recognized standards for hydrogen stations and parts thereof. Such standards for the hardware should give 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 essential safety requirements stated in the legislation. Such standards are normally not legally binding in Scandinavia and Europe. Therefore, strictly, from a legal point of view, other specifications may also fulfil the requirements in the legislation. However, if other specifications have been applied than national recognized standards, difficulties may arise in proving compliance with the legislative requirements. Therefore, standards recognized in the country are important.

Such standards should enable designers and verifyers to achieve sufficient details, on how to design and verify equipment to fulfil the legislative requirements. Furthermore, they should have a quality which makes them usable without allowing significant differences in interpretations of the requirements and usable for verification purposes (1st, 2nd or 3rd party verifications).

To facilitate global harmonization, standards in Europe and Scandinavia for hydrogen stations and parts thereof should be based on international standards as far as possible, such as for example Technical Specification ISO/TS 20100 Gaseous hydrogen – Fuelling stations (at the time of publication of this report, this standard was subject to revision). This makes it important for European and Scandinavian stakeholders, including relevant authorities, to act in international standardization bodies such as ISO and IEC, to cover safety provisions in Europe and Scandinavia for hydrogen stations and parts thereof.

To achieve international standards with good quality and without safety gaps, means should be assured to promote competent persons to be involved in the standardization work. Ideally such a competence should cover:
- good knowledge in European and Scandinavian safety requirements
- good knowledge in standards writing
- experiences in verification of requirements in standards
- an ability to put such knowledge and experiences into practice in cooperation with others, when developing an international standard

# 4 Certification and approval procedures for hydrogen fuelling stations – hydrogen metering accuracy, hydrogen quality and environmental aspects

## 4.1 Overview - Metering accuracy

### 4.1.1 EU provisions applicable for Scandinavia

The European Parliament has issued the **Directive 2004/22/EU** on measuring instruments. This directive covers various categories of measuring instruments. Annex MI-002 describes gas meters and volume conversion devices. 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.

### 4.1.2 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.

#### 4.1.2.1 OIML R 117-1 edition 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.

#### 4.1.2.2 OIML R 137-1 edition 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.

#### 4.1.2.3 OIML R 139 edition 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.

#### 4.1.2.4 OIML R 140 edition 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).

## 4.2 Overview – Hydrogen quality and environmental aspects

The quality of the hydrogen delivered to fuelling stations is not specified by any legislative authorities. The commercial quality/grade of 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 Society of Automotive Engineers International (SAE) has proposed a Hydrogen Fuel Quality Specification Guideline. Therefore, the car manufacturers require a purity of hydrogen for fuel cell vehicles as described in SAE J2719 and ISO 14687-2. 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 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 with nitrogen, then in balance with hydrogen. In this way the quality (purity) of the hydrogen used for vehicles can be accurately determined.

# 4.3 Sweden

## 4.3.1 Legislative requirements

### 4.3.1.1 Hydrogen metering accuracy

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

**Table 4.3.1.1-1** Swedish authority responsible for regulations related to fuel metering accuracy

| Authority (in Swedish) | Authority (in English) | Abbre-viation | Home page |
|---|---|---|---|
| SWEDAC<br>Styrelsen för ackreditering och teknisk kontroll | SWEDAC<br>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. This requirement covers measuring systems for continuous- and for dynamic measurement of quantity of other liquids than water.

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

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
- Swedish national legislations
- Awaiting the ongoing activities at EU-level

Due to legislative and practical reasons, there is a high probability that any new legislation will be harmonised towards today's recommendations and general practice.

### 4.3.1.2 Hydrogen quality and environmental aspects

SWEDAC is not involved in any legislation regarding any fuel quality.

## 4.3.2 Approval procedures

### 4.3.2.1 Hydrogen metering accuracy

No approval procedures exist currently. There is a general exemption for all fuels that are in the state of gas when they are filled in a fuelling station.

### 4.3.2.2 Hydrogen quality and environmental aspects

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

# 4.4 Norway

## 4.4.1 Legislative requirements

### 4.4.1.1 Hydrogen meter accuracy

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 4.4.1.1-1** 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 will be taken by the Ministry of Trade and Industry during 2010 whether there will be still no legislation for the gas metering accuracy or if new legislations will be introduced.

### 4.4.1.2 Hydrogen quality and environmental aspects

Hydrogen purity:
Currently, no legal requirements exist regarding the purity of hydrogen.
See also the general information in clause 4.2.

## 4.4.2 Approval procedures

### 4.4.2.1 Hydrogen metering accuracy

Currently no approval procedures exist. There is a general exemption for all fuels that are in the state of gas when they are filled in a fuel station.

### 4.4.2.2 Hydrogen quality and environmental aspects

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

# 4.5 Denmark

## 4.5.1 Legislative requirements

### 4.5.1.1 Hydrogen metering accuracy

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.

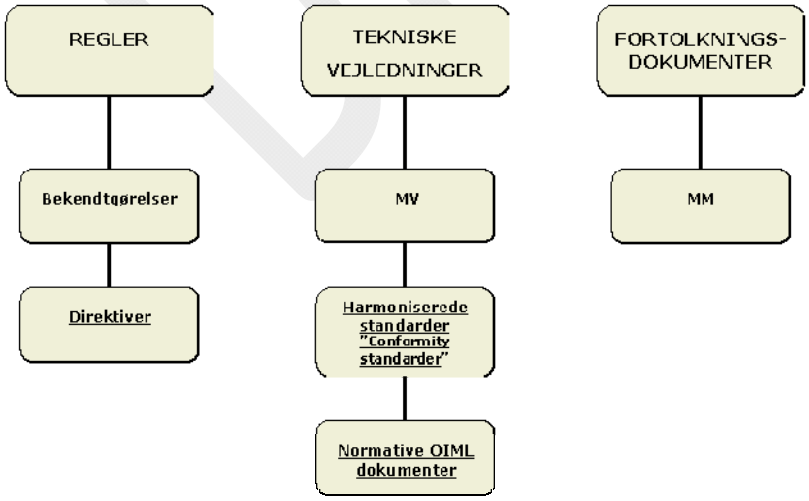
**Table 4.5.1.1-1** Danish authority responsible for regulations related to fuel metering accuracy

| 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 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:



#### 4.5.1.2 Hydrogen quality and environmental aspects

Hydrogen purity:
Currently, no legal requirements exist regarding purity of hydrogen.
See also the general information in clause 4.2.

### 4.5.2 Approval procedures

#### 4.5.2.1 Hydrogen metering accuracy

Sikkerhedsstyrelsen is the approval authority for the Danish market.

#### 4.5.2.2 Hydrogen fuel quality and environmental aspects

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

# 5 Certification and approval procedures for hydrogen fuel cell cars – safety aspects

## 5.1 EU provisions applicable for Scandinavia

The European **Regulation (EC) No 79/2009** for hydrogen-powered motor vehicles, addresses legislative requirements for hydrogen fuel cell cars. This regulation will come 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 in Scandinavia without the need for any legislative actions in the Scandinavian countries.

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 requires new hydrogen-powered vehicles - and hydrogen components and systems for such vehicles - to be type-approved according to the regulation. By this regulation, 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.

From 24 February 2011 the regulation requires all new types of hydrogen-powered vehicles on ground, and components and systems for such vehicles, to comply with the regulation. 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, sold and put into service after 24 February 2012.

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) 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

At international level, a GTR (Global Technical Regulation) based on Japanese regulations is under development by an initiative involving Japan, the 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 cycle life time for onboard pressure vessels in different regions, depending on a different extent of control of cars in use.

Hydrogen fuel cell 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.

## 5.2 Sweden

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

**Table 5.2-1** Swedish authority responsible for type approval and registration of cars (incl. hydrogen fuel cell 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 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.

## 5.3 Norway

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

**Table 5.3-1** Norwegian authority responsible for type approval and registration of cars (incl. hydrogen fuel cell 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 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.

## 5.4 Denmark

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

**Table 5.4-1** Danish authorities responsible for type approval and registration of cars (incl. hydrogen fuel cell 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 cars based on EU provisions according to clause 5.1 above, Denmark does also have procedures for National Type Approval. Regulations, guidelines etc can be found on homepages of the authorities.

### Case - Think city car

In Denmark a national type approval was received in 2009 from the Danish Transport Authority, for six Think city cars to be used for demonstrations in Copenhagen. 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 Danish national type approval received 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.
- Information from Think Technology, concerning acceptance of increased weight of the cars

Following the national type approval document issued by the Danish Transport Authority, the cars were inspected by Bilsyn in Denmark. Information given by the Danish Transport Authority in the national type approval document was considered at the inspection, for example registration of supplementary technical data from the inspection.

Following the inspection, the cars were registered by SKAT.

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

| | | | |
|---|---|---|---|
| SÄIFS 1998:7<br>Föreskrifter om brandfarlig gas i lös behållare | SÄIFS 1998:7<br>Regulations on portable containers for flammable gases | Sprängämnesinspektionen [2)] | |
| SRVFS 2005:3<br>Föreskrifter om transportabla tryckbärande anordningar | SRVFS 2005:3<br>Regulations on transportable pressure equipment | Sprängämnesinspektionen [2)] | Implements TPED Directive 99/36//EC |
| SÄIFS 1996:3<br>Förbudsanslag, varningsanslag samt märkning av rörledningar | SÄIFS 1996:3<br>Regulations on safety signs, warning signs and marking of pipes | Sprängämnesinspektionen [2)] | |
| SÄIFS 1995:3 (med ändringar enligt 1997:3)<br>Tillstånd till hantering av brandfarliga gaser och vätskor | SÄIFS 1995:3 (with changes according to 1997:3)<br>Regulations on permits for handling of flammable gases and fluids | Sprängämnesinspektionen [2)] | |
| SRVFS 2003:10<br>Föreskrifter om skriftlig redogörelse för brandskyddet | SRVFS 2003:10<br>Regulations on written declarations concerning fire safety | Statens räddningverk [2)] | |
| SRVFS 2004:3<br>Allmänna råd och kommentarer om systematiskt brandskyddsarbete | SRVFS 2004:3<br>Recommendations on systematic fire prevention work | Statens räddningverk [2)] | |
| SRVFS 2004:4<br>Allmänna råd och kommentarer om skriftlig redogörelse för brandskyddet | SRVFS 2004:4<br>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 (in Swedish)** | **Laws, ordinances and regulations [1)] (in English)** | **Issued by** | **Comments** |
|---|---|---|---|
| SFS 1997:857<br>Ellagen | SFS 1997:857<br>The Electricity Act | Parliament | |
| SFS 1992:1512<br>Lag om elektromagnetisk kompatibilitet | SFS 1992:1512<br>Act concerning Electro-magnetic Compatibility | Parliament | Implements EMC Directive 2004/108/EC |
| SFS 2009:22<br>Starkströmsförordningen | SFS 2009:22<br>Ordinance concerning electrical heavy current Installations | Government | |
| SFS 1990:806<br>Elinstallatörsförordningen | SFS 1990:806<br>Electrical installation ordinance | Government | |
| SFS 1993:1068<br>Förordning om elektrisk materiel | SFS 1993:1068<br>Ordinance concerning electrical equipment | Government | Implements LVD 2006/95/EC |
| SFS 1993:1067<br>Förordning om elektromagnetisk kompatibilitet | SFS 1993:1067<br>Ordinance concerning Electromagnetic Compatibility | Government | Implements EMC Directive 2004/108/EC |
| ELSÄK-FS 1995:6<br>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 2006:1<br>Elsäkerhetsverkets föreskrifter och allmänna råd om elsäkerhet vid arbete i yrkesmässig verksamhet | ELSÄK-FS 2006:1<br>The Swedish National Electrical Safety Board's regulations and general advice on electrical safety for work in professional activity | ELSAK | |
| ELSÄK-FS 2008:1<br>Elsäkerhetsverkets föreskrifter och allmänna råd om hur elektriska starkströmsanläggningar ska vara utförda | ELSÄK-FS 2008:1<br>The Swedish National Electrical Safety Board's regulations regarding design and erection of electrical heavy current installations and general advice when applying these regulations | ELSAK | |
| ELSÄK-FS 2008:2<br>Elsäkerhetsverkets föreskrifter och allmänna råd om varselmärkning vid elektriska | ELSÄK-FS 2008:2<br>The Swedish National Electrical Safety Board's regulations regarding electrical warning hazard | ELSAK | |

| | | | |
|---|---|---|---|
| starkströmsanläggningar | signs and labels of electrical heavy current installations and general advice when applying these regulations | | |
| ELSÄK-FS 2008:3<br>Elsäkerhetsverkets föreskrifter och allmänna råd om innehavarens kontroll av elektriska starkströmsanläggningar och elektriska anordningar. | ELSÄK-FS 2008:3<br>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<br>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 (in Swedish)** | **Laws, ordinances and regulations [1)] (in English)** | **Issued by** | **Comments** |
|---|---|---|---|
| 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 all- | AFS 1995:5 The Work Environment Authority's regulations concerning equipment intended for use in | AV | Implements ATEX Product Directive 94/9/EC for other equipment than electrical equipment |

| | | | |
|---|---|---|---|
| männa råd om tillämpningen av föreskrifterna | potentially explosive atmospheres and general advice when applying these regulations | | |
| AFS 2008:3<br>Arbetsmiljöverkets föreskrifter om maskiner samt allmänna råd om tillämpningen av föreskrifterna | AFS 2008:3<br>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<br>Arbetarskyddsstyrelsens föreskrifter om tryckbärande anordningar samt allmänna råd om tillämpningen av föreskrifterna | AFS 1999:4<br>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<br><br>Applies for equipment with over pressures exceeding 0,5 bar. |
| AFS 2002:01<br>Arbetsmiljöverkets föreskrifter om användning av trycksatta anordningar samt allmänna råd om tillämpningen av föreskrifterna | AFS 2002:1<br>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<br>Arbetsmiljöverkets föreskrifter om tillverkning av vissa behållare, rörledningar och anläggningar samt allmänna råd om tillämpningen av föreskrifterna | AFS 2005:2<br>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<br>Arbetsmiljöverkets föreskrifter om besiktning av trycksatta anordningar samt allmänna råd om tillämpningen av föreskrifterna | AFS 2005:3<br>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)<br>Arbetarskyddsstyrelsens föreskrifter om enkla tryckkärl samt allmänna råd om tillämpningen av föreskrifterna | AFS 1993:41 (reprinted as 1994:53)<br>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)<br>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 föreskrif-terna | 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. |

[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.

# 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 (in Norwegian)** | **Laws and regulations (in English)** [1)] | **Issued by** | **Comments** |
|---|---|---|---|
| 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 | |
| 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 | |
| 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 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 2009-05-20 nr 544: Forskrift om maskiner | FOR 2009-05-20 nr 544: Regulation concerning machinery | DAT | Implements e.g. Machinery Directive 2006/42/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 |
| 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 (in Norwegian) | Laws and regulations (in English) [1)] | Issued by | Comments |
|---|---|---|---|
| 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 | |
| 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 |
| 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.

**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 (in Danish) | Laws and regulations (in English) [1)] | Issued by | Comments |
|---|---|---|---|
| LBK nr 990 af 08/12/2003 om elektriske stærk-strømsanlæg og elektrisk materiel (Stærkstrømsloven) | LBK nr 990 af 08/12/2003<br>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<br>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<br>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<br>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<br>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<br>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<br>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, ordinances and regulations (in Danish)** | **Laws, ordinances and regulations [1)] (in English)** | **Issued by** | **Comments** |
|---|---|---|---|
| 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 Bekendtgørelse om simple trykbeholdere | BEK nr 565 af 24/06/1994 Order on simple pressure vessels | AT | Implements SPVD Directive 87/404/EEC (replaced by 2009/105/EC)<br>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 (in Danish) | Laws and regulations (in English) [1)] | Issued by | Comments |
|---|---|---|---|
| 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 National IT and Telecom Agency (ITST)
***IT- og Telestyrelsen***

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

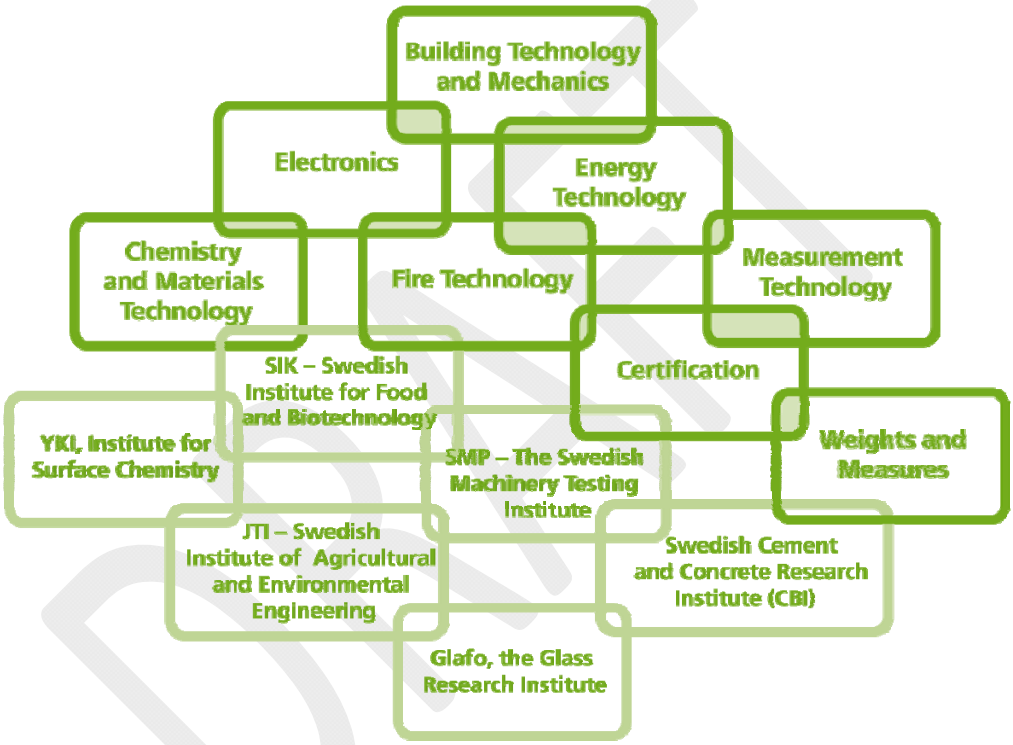
| Laws and regulations (in Danish) | Laws and regulations (in English) [1)] | Issued by | Comments |
|---|---|---|---|
| LBK nr 823 af 03/07/2007 Bekendtgørelse af lov om radio- og teleterminaludstyr og elektromagnetiske forhold | LBK nr 823 af 03/07/2007 Law on Radio and Telecommunications Terminal 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 | ITST | |

[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.

**SP Technical Research Institute of Sweden**

Our work is concentrated on innovation and the development of value-adding technology. Using Sweden's most extensive and advanced resources for technical evaluation, measurement technology, research and development, we make an important contribution to the competitiveness and sustainable development of industry. Research is carried out in close conjunction with universities and institutes of technology, to the benefit of a customer base of about 9000 organisations, ranging from start-up companies developing new technologies or new ideas to international groups.




**SP Technical Research Institute of Sweden**
Box 857, SE-501 15 BORÅS, SWEDEN
Telephone: +46 10 516 50 00, Telefax: +46 33 13 55 02
E-mail: info@sp.se, Internet: www.sp.se
**www.sp.se**

Electronics
SP Report 2010:82
ISBN 978-91-86622-24-4
ISSN 0284-5172

More information about publications published by SP: **www.sp.se/publ**