Ds 2011:35

Sweden's fourth national report under the

Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management

Swedish implementation of the obligations of the Joint Convention

REGERINGSKANSLIET

Ministry of the Environment
Sweden

This page is intentionally left blank

Ds 2011:35

Sweden's fourth national report under the Joint Convention on the safety of spent fuel management and the safety of radioactive waste management

Swedish implementation of the obligations of the Joint Convention

REGERINGSKANSLIET

Ministry of the Environment

This report is on sale in Stockholm at Fritzes Customer Service,
which sells reports in the series Swedish Government Official Reports (SOU)
and in the Ministry Publications Series (Ds).

Address: Fritzes, Customer Service
SE-106 47 Stockholm
Sweden
Fax: 08 598 191 91 (national)
+46 8 598 191 91 (international)
Telephone: 08 598 191 90 (national)
+46 8 598 191 90 (international)
E-mail: order.fritzes@nj.se
Internet: www.fritzes.se

Printed by Elanders Sverige AB
Stockholm 2011

ISBN 978-91-38-23635-2
ISSN 0284-6012

Contents

List of Tables and Figures

Foreword

Sweden has been active for many years in the international effort to enhance nuclear safety and radiation protection with regard to the operation of nuclear reactors as well as the management of spent fuel and radioactive waste. The Convention on Nuclear Safety was an important first step to deal with the most immediate safety issues, i.e. the safety of operation of commercial nuclear power reactors. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management constitutes another important step by promoting the safe handling and disposal of spent fuel and radioactive waste.

The areas covered by the Joint Convention have been incorporated in the Swedish system for spent fuel and radioactive waste management for a long time. The Swedish Government considered at the time of signing the Joint Convention that the safety philosophy, legislation and the safety work conducted by the licensees and the authorities in Sweden complied with the obligations of the Convention.

A summary of highlights and issues raised about Sweden during the third review meeting May 11 to 20, 2009 can be found in section A.2. This section also includes an overview of those issues Sweden was asked to report about in its fourth national report (i.e. the present report). A summary of developments since the last national report can be found in section A.3.

This report has been produced by a working group with representatives from, the Swedish Radiation Safety Authority (SSM) and the Swedish Nuclear Fuel and Waste Management Co (SKB). It constitutes an up-dated document with basically the same structure as the previous national reports under the Joint Convention, although the information in section A, Introduction, has been slightly reorganized. Before submission to the Government for formal approval the report was sent for comments to relevant organizations including the nuclear industry.

This page is intentionally left blank

A.1 Purpose and structure of this report

Sweden signed Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) September 29, 1997. Sweden ratified the Joint Convention about two years later and is a Contracting Party to the Joint Convention since July 29, 1999. The Joint Convention entered into force on June 18, 2001.

Each member nation having ratified the Joint Convention (Contracting Party) is obligated to prepare a National Report covering the scope of the Joint Convention and subject it to review by other Contracting Parties at Review Meetings held in Vienna, Austria. Sweden participated in the First Review Meeting in November 2003, the Second Review Meeting in May 2006 and the Third Review Meeting in May 2009. This report is the fourth Swedish National Report under the Joint Convention.

This report satisfies the requirements of the Joint Convention for reporting on the status of safety at spent fuel and radioactive waste management facilities within Sweden. It constitutes an updated document with basically the same structure as the previous national reports under the terms of the Joint Convention and reflects developments in Sweden through December 2010. It will be subject to review at the Fourth Review Meeting of the Contracting Parties in Vienna, Austria, in May 2012.

The report format and content follow the revised guidelines for structure and content of the report, as agreed at the Second Review Meeting of Contracting Parties to the Joint Convention in May 2005. Chapters in this report have the same titles as in these guidelines, facilitating review by other Contracting Parties. Table A1 provides a cross-reference between the chapters in this report and the specific reporting provisions in the Joint Convention.

National Report Section	Joint Convention Section
A. Introduction	
B. Policic and Practices	Article 32, Paragraph 1
C. Scope of Application	Article 3
D. Inventories and Lists	Article 32, Paragraph 2
E. Legislative and Regulatory Systems	Article 18; Article 19; and Article 20
F. General Safety Provisions	Articles 21-26; Articles 4-9; Articles 11-16
G. Safety of spent Fuel Management	Articles 4-10
H. Safety of Radioactive Waste Management	Articles 11-17
I. Transbounddary Movement	Article 27
J. Disused Sealed Sources	Article 28
K. Planned Activities to Improve Safety	Multiple Articles
L. Annexes	Multiple Articles

Table A1: Joint Convention Reporting Provisions

Section A.2 provides for a summary of highlights and issues raised about Sweden during the third review meeting. This section also includes an overview of those issues Sweden was asked to report about in its fourth national report (the present report).

Section A.3 contains a summary of developments since the previous national report.

Section A.4 provides information about the new regulatory authority, the Swedish Radiation Safety Authority, as well as on the Committee of Inquiry on harmonising the Swedish acts regulating activities in the field of nuclear technology and radiation protection.

Section A.5 provides some basic information about the development of a national strategy and its transformation into a national programme for management of spent fuel and nuclear waste.

Section A.6 presents an overview of the existing management system for spent fuel and nuclear waste.

Section A.7 contains an account for Swedish participation in international activities.

Section B provides information on policies and practices according to Article 32.1 of the Convention.

Section C addresses scope of the report according to Article 3 of the Convention.

Section D provides information on inventories and lists according to Article 32.2 of the Convention.

Section E presents the legislative and regulatory system according to Articles 18,19 and 20 of the Convention.

Sections F to J include facts and information to substantiate compliance with the obligations of the Convention. Every chapter in these sections corresponds to one Article of the Convention. The chapters in sections F to J have a similar structure where information is provided about the regulatory requirements related to the respective Article. In addition, information is provided about measures taken by the licence holders to comply with the regulatory requirements as well as own safety initiatives. Finally, information is provided about the means used by the regulatory bodies to supervise the measures taken by the licence holders. Taken together this will provide evidence for meeting the obligations of the Convention.

A.2 Summary results from the previous review

During the period before the third review meeting, Sweden received in total 132 questions on the report from 21 countries. The questions touched several articles of the Joint Convention and were mostly requests for clarifications, additional information and reports on experiences with specific practices. All questions were answered on the Joint Convention website and commented in a general sense at the review meeting.

During the discussion at the review meeting it was agreed that Sweden seems to comply well with the obligations of the Joint Convention. It was concluded that a comprehensive regulatory framework is in place focusing on targets rather

than prescriptive requirements. Sweden has made good progress in realisation of repository projects and the existing policy of transparency and openness has contributed to a high level of acceptance in the public with regard to these projects. Another conclusion was that the financing system for decommissioning and disposal is designed to provide funding for the implementation of the Swedish waste management concept.

The meeting emphasized that Sweden is in the forefront of several aspects of spent fuel and radioactive waste management, and expressed a desire for Sweden to provide information on developments in these areas in the next report.

It was noted that Sweden demonstrated good practices with regards to:

- responsibilities for spent fuel and waste safety is clearly defined in the legal framework
- arrangements in place to finance all items related to spent fuel and radioactive waste management as well as decommissioning
- funding mechanism is available for costs for orphan sources and other legacy waste
- long term strategy is in place for disposal of spent fuel and nuclear waste
- provisions for transparency of nuclear activities in legislation
- extensive public consultation in the decision making process
- constructive relationship between regulatory bodies and licensees

The following challenges were identified for the future development as regards management of spent fuel and radioactive waste:

- Continued implementation of the long term strategy to complement the existing management system for spent nuclear fuel and nuclear waste, i.e. siting and licensing of new facilities (e.g. an encapsulation plant and a spent fuel disposal facility). Development in this regard is found in section A.6..3.2.
- Implementation of improvements to the system of management of non-nuclear waste. Development in this regard is found in section A.5.3.
- Integration of organisations and regulatory practices after merging the previously existing regulatory authorities (the Swedish Nuclear Power Inspectorate, SKI, and the Swedish Radiation Protection Authority, SSI). Development in this regard is found in section A.4.1
- Development of strategies and approaches for assuring adequate human resources for SSM. Development in this regard is found in section A.4.1.

Sweden was asked to report at the next review meeting in particular on the following planned measures to improve safety:

- License application for the repository for spent nuclear fuel planned for mid-2010. Development in this regard is found in sections A.6.3.2.
- License application for the extension of the SFR for both operational and decommissioning waste planned for 2013. Development in this regard is found in sections A.6.3.3.
- Development of waste acceptance criteria for long-lived waste. Development in this regard is found in sections A.6.3.3.
- Development of a strategic National Waste Management Plan addressing both nuclear and non-nuclear waste management. Development in this regard is found in sections A.5.3.

A.3 Summary of developments since previous report

In order to provide continuity from the second review meeting, the rapporteur's matrix has been revised and supplemented with references to explanatory sections of the report, in table 1.

TYPE OF LIABILITY	LONG-TERM MANAGEMENT POLICY	FUNDING OF LIABILITIES	CURRENT PRACTICE / FACILITIES	PLANNED FACILITIES
SPENT FUEL	NPP licensees jointly responsible. Strategy in place for disposal	Funded by fees on production of nuclear energy collected in segregated funds (Nuclear Waste Fund)	Stored on site initially, then transferred to central interim storage facility (Clab)	Licence application for spent fuel disposal facility under review
See section	*A.5.1, A.5.2, A.5.2.4, B.1.1*	*A.5.2.6, E.2.2.5, F.2.1.2*	*A.6.2, A.6.2.1, B.1.2, D.1.2.3*	*A.6.5.3, E.2.2.1, G.4.2.42*
NUCLEAR FUEL CYCLE WASTES	NPP licensees jointly responsible. Strategy in place for disposal	Funded by fees on production of nuclear energy collected in Nuclear Waste Fund Disposal of short-lived operational LILW waste (SFR) from NPPs paid for directly by owners	Short-lived LILW disposal at existing repository (SFR); Shallow land burial sites for VLLW short-lived waste exist at NPP sites	Preliminary plans for disposal facility for long-lived LILW (SFL). License application expected 2030
See section	*A.5.1, A.5.2, A.5.2.4, B.1.3*	*A.5.2.6, E.2.2.5, F.2.1.2*	*A.6.2, A.6.2.2, B.1.4*	*A.6.3.3, H.5.2*
NON-POWER WASTES	Strategy in place for disposal – Further actions on-going	Funded by producers/ owners of waste Government funding available for legacy wastes	Short-lived LILW disposal at existing facilities for nuclear fuel cycle waste (SFR) when appropriate; Long-lived LILW to be interim storage pending disposal in facility for long-lived LILW nuclear fuel cycle waste (SFL)	To be disposed of in planned disposal facility for long-lived LILW nuclear fuel cycle waste (SFL)
See section	*A.5.3*	*J.1.2*	*D.1.4.2*	*J.1.2*
DECOMMISSIONING LIABILITIES	Licensee is responsible	Funded by producers/owners of waste	Preliminary plans for decommissioning exist; Reviews of the adequacy of funding on-going	Short-lived LILW to be disposed of in extension to existing SFR facility License application for extension expected in 2013 Long-lived LILW to be disposed of in planned disposal facility for long-lived LILW nuclear fuel cycle waste (SFL)
See section	*A.5.2.4*	*A.5.2.6, E.2.2.5, F.2.1.2*	*F.6.2, G.6.2.7*	*A.6.3.3, H.5.2, K.3*
DISUSED SEALED SOURCES	Returned to manufacturer	Funded by producers/ owners of waste Government funding available for orphan sources	Returned to manufacturer, disposed of in SFR, or in interim storage pending disposal in facility for long-lived LILW nuclear fuel cycle waste (SFL)	To be disposed of in disposal facilities for nuclear fuel cycle wastes (SFR, SFL) as appropriate
See section	*J.1*	*E.2.2.5, J.1*	*J.1*	*J.1*

Table A2: Revised overview of the Swedish programme for management and disposal of spent nuclear fuel and radioactive waste.

The main elements in progress made since the third review meeting is summarized below:

- The Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Authority (SSI) were merged into a joint organization, the Swedish Radiation Safety Authority, July 1, 2008.
- Regulations from the former regulatory authorities have been reissued as Swedish Radiation Safety Authority regulations.
- On January 1, 2011 the previous ban on constructing new reactors was removed through amendments to the Act (1984:3) on Nuclear Activities and the Environmental Code, i.e. old reactors in Sweden may be replaced by new ones.
- A Committee of Inquiry on merging the provisions of the Act on Nuclear Activities and the radiation Protection Act (1988:220) has submitted its final report to the Government (SOU 2011:18).
- By a new Ordinance on Supervision under the Environmental Code SSM on March 31, 2011 took over the supervisory authority for matters relating to radiation safety under the Code from the County Administrative Boards.
- The Parliament has approved a Government Bill containing a proposal to extend the obligation to pay fees under the Studsvik Act until December 31, 2017.
- The arrangement for financial support to non-profit-making organizations to participate in the licensing process for establishing a spent nuclear fuel disposal facility has been prolonged.
- SKB has since July 1, 2009, taken over the operation of the disposal facility for short-lived low- and intermediate level waste (SFR) in Forsmark.
- SKB in September 2010 submitted the RD&D-programme 2010, the ninth RD&D-programme on since 1986. The regulatory authorities have evaluated the programme and submitted a statement to the Government.
- SKB in January 2011 submitted updated cost estimates to be used for the determination of fees to be paid by the nuclear power plant owners organization to the Nuclear Waste Fund for the years 2012 through 2014.
- SKB in November 2009 submitted supplementary material to the license application for an encapsulation plant. The regulatory review of the application will be co-ordinated with the review of a license application for a disposal facility for spent nuclear fuel under the Act (1984:3) on Nuclear Activities and the Environmental Code.
- SKB in March 2011 submitted a license application to site and construct a disposal facility for spent nuclear fuel, at Forsmark in the municipality of Östhammar. The regulatory review of the application will be co-ordinated with the review of a license application for the encapsulation plant under the Act (1984:3) on Nuclear Activities and the Environmental Code.
- SKB has initiated a process of regular consultation meetings with SSM on the planned extension of the disposal facility for short-lived long- and intermediate level waste (SFR) and relicensing of the facility to accommodate also decommissioning waste.
- SSM in June 2009 submitted a national waste management plan to the Government on the management and disposal of radioactive waste generated outside of the nuclear fuel cycle.
- By a government decision, AB SVAFO in December 2010 obtained the nu-

clear license for R2 and R2-0, which earlier belonged to Studsvik Nuclear AB. This means AB SVAFO will now be responsible for the further decommissioning work.
- As a follow-up to the TEPCO Fukushima Dai-ichi NPP nuclear accident, SSM, on May 25 2011, decided that the NPP licensees and SKB shall redo the safety assessments for the NPPs and for the interim storage for spent nuclear fuel at Clab at Oskarshamn.

A.4 Developments as regards the legal and regulatory infrastructure

A.4.1 The Swedish Radiation Safety Authority

The Swedish Radiation Safety Authority (SSM) was formed on July 1, 2008, in a merger between the former authorities the Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Authority (SSI). The motives for this change were:
- A general ambition by the Government to reduce the number of authorities and make the Swedish civil service more efficient
- A more efficient use of common resources for the supervision of nuclear facilities – where inspections will benefit from an integrated perspective
- An integrated competence within nuclear safety and radiation protection that will lead to a reinforced supervision of both nuclear and non-nuclear activities
- It will be easier for the licensees and other stakeholders to deal with one regulatory body, the risk for contradictory rules and decisions will be eliminated

SSM has been in operation as a regulatory authority for three years. The build-up is completed and although this required extra efforts and some temporary limitations, the supervising capacity was never jeopardized. The merger of the two authorities was done "within the existing budget" but SSM has since received additional funding to enhance its supervising activities.
Some of the difficulties encountered, some common to organisational change in general, were/are:
- The differences in "work culture" of the earlier authorities were overcome by active efforts in which all staff was involved in establishing the work methods, vision and core values of the new authority. In addition, the rapidly increasing number of new employees has been a positive challenge in forming the new authority.
- The different terminology used in the radiation protection field and the nuclear safety area (safety, justification, optimisation, protection, graded approach etc.) has created some practical problems in communication and regulatory work. This will partly be resolved by the Government suggested new legislation which will include definitions on basic key terms.
- The objective of reinforcing the supervision in the nuclear field and towards hospitals is under way but the initial judgment of needed resources was underestimated. An initial loss of some experienced inspectors took 1-2 years to overcome.
- The creation of a new authority automatically resulted in many work hours being allocated to build-up of the organisation and internal activities, and less resources for supervision, information, communication etc. However, the

priorities were set in such a way that the prime safety and radiation protection functions of the SSM (e.g. emergency preparedness, major safety inspections and controls, licensing of high activity sources) was never negatively affected by the internal activities during the build-up phase.

Some of the observed positive results are:

- SSM is better prepared (than the two earlier authorities) to assess applications from the nuclear industry and in particular the recent application for a spent nuclear fuel disposal facility.
- The merged resources have created better conditions for development of an effective management system, modernization of the authority work and administrative procedures, including the investment in documentation systems and new electronic technologies .
- The new authority can use its research resources in a more effective way, especially in areas where the former SKI and SSI had shared responsibilities.
- The common competences are used more efficiently, e.g. the expertise in the area of human factors of the former authority SKI is now used in other supervision areas.
- Inspection models have been shared between the different supervision fields. As examples, the concept of "special supervision" has been applied to hospitals and "rapid investigations" were performed at a fuel factory and in connection with an accident with x-ray equipment.
- SSM is better prepared to handle nuclear emergencies and radiological crises, which was evident in the authority taking a central role in the Swedish response to the recent Fukushima Dai-ichi NPP nuclear accident.

More information on the Swedish Radiation Safety Authority is found in section E.3.1.2 and on the SSM web-site: www.ssm.se.

A.4.2 Legislative amendments and proposals in the nuclear field

A.4.2.1 Amendments

Controlled generational shifts in the Swedish stock of nuclear power facilities
The parliament has decided to abolish the Nuclear Power Phase-Out Act and to remove the ban to construct new nuclear reactors in the Act on Nuclear Activities. Amendments made to the Environmental Code and the Act on Nuclear Activities provide the conditions for controlled generation shifts in Swedish nuclear power, making it possible to gradually replace existing nuclear power reactors with new ones. One precondition for obtaining the permission to construct new reactors in Sweden is that the new reactor replaces one of the older reactors and that the older reactor is permanently shut down. The legal definition of a permanently shut down reactor is as follows; " a reactor where the production of electricity has ceased and will not be restarted, or a reactor that has not supplied electricity to the grid for the last five years". The new nuclear power reactors may only be constructed on one of the sites where present reactors that are in operation are located. These changes entered into force 1 January 2011.

Requirement of a regular overall assessment of reactor safety and the impact on security of supply in the area of electricity generation
The requirement in SSM:s general safety regulations SSMFS 2008:1, that nuclear plants shall conduct a unified analysis and overall assessment of safety at each nuclear power reactor at least every ten years, has been transferred to the Act on Nuclear Activities to emphasise its importance as a safety principle. The amendment entered into force 1 August 2010.

Extension of obligation for reactor operators to pay a fee to the Studsvik Act
In June 2011 the Parliament approved a Government Bill containing a proposal to extend the obligation to pay fees under the Studsvik Act until December 31, 2017. The reformed legislation will enter into force on 1 January 2012.

A.4.2.2 Proposals

Inquiry on Coordinated Regulation in the Nuclear Safety and Radiation Protection Field
The Head of the Ministry of the Environment on 11 December 2008 appointed a Committee of Inquiry on harmonising the rules concerning activities in the field of nuclear technology and radiation protection.

The Inquiry's final report (SOU 2011:18) was submitted to the Government February 2011. The report is currently sent out to a large number of referral respondents, including SSM.

The Inquiry suggests that the provisions in the Act on Nuclear Activities and the Radiation Protection Act are integrated in their entirety into the Environmental Code. No substantive material changes to the legislation are proposed.

The Inquiry suggests the introduction of the term **"Radiation safety"** which should be used as a collective designation for:

a) **radiation protection:** the protection of people and the environment against the harmful effects of radiation, through justification of use, optimisation of protective measures and the limitation of radiation doses and exposure risks,
b) **safety:** protection against the harmful effects of radiation by taking whatever steps are necessary to prevent defects in equipment, equipment failure, wrong handling or other circumstances that may lead to accidents, and to facilitate the combating of breakdowns and the limitation or delay of emissions should an accident nevertheless occur,
c) **physical protection:** protection of operations, facilities and equipment against incursions, unauthorised use, theft, sabotage or other action liable to cause harm through radiation.
d) **non-proliferation:** measures designed to prevent the proliferation of nuclear weapons at both national and international level, and measures to verify that such proliferation is not occurring.

At the earliest the proposed legislative changes could enter into force during 2013 or 2014.

A.5 General overview and context

A.5.1 Development of a National Strategy

Past practices
No formal requirements for the management of spent fuel and nuclear waste were established in Sweden until the late 1970's. Therefore, a study was initiated in the mid-1990's with the objective to better understand past practices regarding management of radioactive waste. This knowledge is important to allow for the proper and safe conditioning and disposal of old waste still in storage.
The study focused on the management of radioactive waste containing plutonium from research activities. Activities that generated plutonium-containing waste have been identified as well as the treatment, storage, and in certain cases, dumping at sea of the waste produced. Sea dumping of radioactive waste was limited to low-level waste and occurred in Swedish territorial waters as well as in the Atlantic. The last dumping occurred at the end of the 1960's. Since 1971 sea dumping is prohibited in Sweden.

Early activities that generated most of the spent fuel and radioactive waste in Sweden were:
- The research reactor R1 (the first research reactor, 1954-1970),
- The Studsvik site (a research institute established 1958 for the Swedish nuclear programme, with research reactors in operation 1958-2005), and
- The Ågesta district heating nuclear power reactor (the first power reactor in Sweden, in operation 1964-1974).

Historical wastes are often varying with regards to categorization, measurements accuracy and conditioning. Such wastes are connected to the early research and development of the Swedish nuclear programme. These wastes are with very few exceptions managed at the Studsvik facilities, situated 100 km south of Stockholm, outside Nyköping. The treatment and conditioning of these wastes have been managed on a case-by case basis and the regulatory authority has opted to have early in-sight in these projects and to handle them, both their regulation and control, on a case-by-case basis. The final waste packages, however, must fit into the available waste streams of the Swedish disposal programme and, to the extent possible, fulfill the general requirements of the regulations.

The option of a nuclear weapons programme
As early as in August 1945, Sweden decided to evaluate the then new situation regarding atomic weapons. The main aim of the research was to find out how Sweden could best protect itself against a nuclear weapon attack. However, from the outset there was an interest in investigating the possibilities of manufacturing nuclear weapons. In 1968, the Swedish government signed the Non-Proliferation Treaty, thus ending the discussions on a Swedish nuclear weapons programme.

Reprocessing
Swedish policy was originally based on the assumption that reprocessing and plutonium recycling would form attractive and desirable elements of the nuclear fuel cycle. However, the construction of a reprocessing plant in Sweden was not envisaged. As commercial nuclear power plants were built in the early 70's,

arrangements were made therefore to send the spent nuclear fuel abroad for reprocessing.

During the late 1970's attitudes changed, and reprocessing was, for various reasons (including non-proliferation aspects), not considered an acceptable method for the management of spent nuclear fuel. The current policy regarding the management of spent nuclear fuel was established in the late 1970's, and aims at direct disposal without reprocessing.

In 1969 the Swedish nuclear power company, OKG, signed a contract with the United Kingdom. Atomic Energy Agency, which was later taken over by The British Nuclear Fuel Limited (BNFL), for the reprocessing of spent nuclear fuel from OKG in Windscale (later Sellafield). In all 140 tons of fuel was shipped to Sellafield between 1972 and 1982. The fuel was reprocessed in 1997 and resulted in 136 tons of uranium and 833 kilograms of plutonium. OKG plans to manufacture and use the recovered plutonium in about 80 MOX-fuel elements.

Between 1978 and 1982 an agreement was made between the Swedish Nuclear Fuel Supply Company (SKBF, later renamed SKB) and Compagnie Générale des Matières Nucléaires (COGEMA) regarding the reprocessing of 672 tons of spent nuclear fuel from the Barsebäck, Ringhals and Forsmark NPPs.

A total of 55 tons was shipped to La Hague before the contracts were cancelled. The fuel was then exchanged for 24 tons of used MOX-fuel from Germany. The exchange meant that Sweden did not have to build a disposal facility for vitrified waste and Germany did not have to build a disposal facility for used MOX-fuel. The used MOX-fuel from Germany is now stored in the Clab facility.

The 1973 Committee on Radioactive Waste (The AKA-committee)

In 1973 the Government appointed a committee (the Committee on Radioactive Waste) to investigate the problem of handling high-level waste from nuclear power plants. The scope of the investigation was later extended to cover essentially all aspects of the back-end of the nuclear fuel cycle. The report from the committee was submitted in 1976 and defines in essence the Swedish national strategy for management and disposal of spent fuel and nuclear waste. The main findings of the committee were:

- Reprocessing of spent fuel was recommended, with disposal of glass or ceramic solidification of the high-level waste in bedrock, but that further studies should be carried out to clarify the conditions for a non-reprocessing scheme, i.e. direct disposal in bedrock.
- Responsibilities of licensees should be more clearly defined in the regulatory framework
- A research- and development programme should be established, subject to regulatory approval
- A financing system to cover costs for treatment, transport and disposal as well as research and development should be established
- A central storage facility for spent fuel should be established.
- A central disposal facility for low- and medium level radioactive waste should be established.

A.5.2 Development of a National Programme

A.5.2.1 Fundamental principles

Principles for the management of spent fuel and radioactive waste have evolved over the years and have been discussed by the Swedish parliament. The allocation of responsibilities is reflected in the Swedish legislation, and is further described in section E.2. The principles can be summarised:

1. The expenses for the disposal of spent nuclear fuel and nuclear waste are to be covered by revenues from the production of energy that has resulted in these expenses.
2. The reactor owners are to safely dispose of spent nuclear fuel and nuclear waste.
3. The state has the ultimate responsibility for spent nuclear fuel and nuclear waste. The long-term responsibility for the handling and disposal of spent nuclear fuel and nuclear waste should rest with the state. After a disposal facility has been closed, a requirement should be established to ensure that some kind of responsibility for and supervision of the disposal facility can be made and maintained for a considerable time. A government authority could assume responsibility for a closed disposal facility.
4. Each country is to be responsible for the spent nuclear fuel and nuclear waste generated in that country. The disposal of spent nuclear fuel and nuclear waste from nuclear activities in another country may not occur in Sweden other than in an exceptional case.

A.5.2.2 Legal & regulatory framework – an overview

The management of spent fuel and nuclear waste is regulated by a series of statutory provisions, of which the three main legislative instruments are:

- The Act on Nuclear Activities (1984:3), which defines the licensing requirements for the construction and operation of nuclear facilities and for handling or using nuclear materials (including radioactive waste).
- The Radiation Protection Act (1988:220), which defines the licensing requirements for radiation protection and for radiological work.
- The Act on Financial Measures for the Management of Residual Products from Nuclear Activities (2006:647) which deals with the main financial aspects, and defines the responsibilities pertaining to the management and disposal of spent nuclear fuel and radioactive waste.

These are the basic principles for the structure of the Act (1984:3) on Nuclear Activities. They are also contained in the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities.

Under the Act on Nuclear Activities the holder of a licence to operate a nuclear reactor is primarily responsible for the safe handling and disposal of spent fuel and radioactive waste produced by the reactor. In addition the holder is responsible - under the Radiation Protection Act - to take all measures and precautions necessary to prevent or counteract injury to human health and the environment by radiation.

The Act on the Financial Measures for the Management of Residual Products from Nuclear Activities is an essential part of the Swedish nuclear waste management system since it lays down the principles for the financing of expenses for decommissioning and disposal of spent nuclear fuel and nuclear waste.

The Environmental Code (1998:808) is also of importance, in particular for the siting and construction of new facilities since amongst other things it regulates the environmental impact statement that must accompany a licence application. Any new nuclear facility must be licensed according to both the Act on Nuclear Activities and the Environmental Code. In both cases the Government grants the licence on the basis of recommendations and reviews of the competent authority.

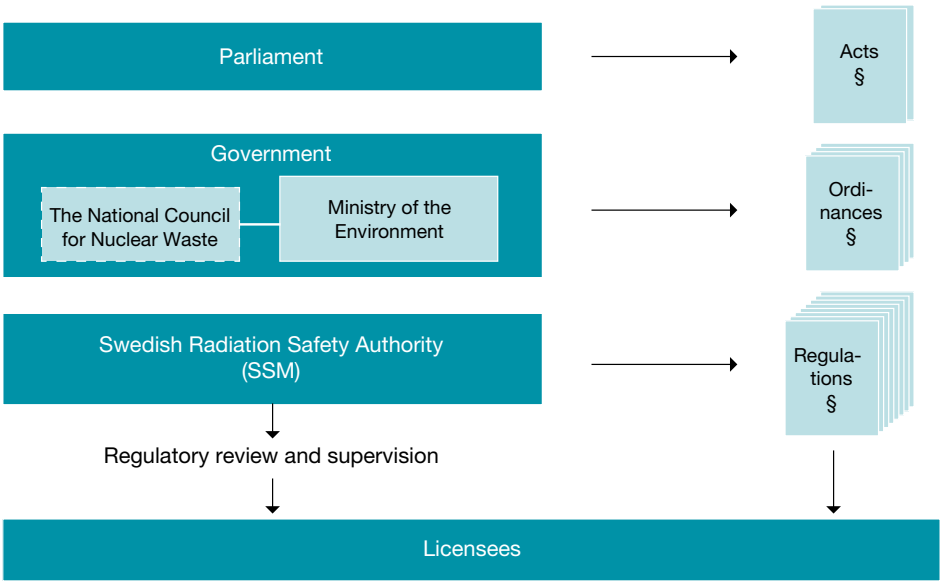


Figure A1: Legal & regulatory framework - organizational structure

A.5.2.3 Licensing system basic principles

On important element in the legal and regulatory framework is the clearly defined step wise licensing process for nuclear facilities. Each decision to grant a license/ authorization to move from one phase to the next is founded on the regulatory review of an application from the implementer, based on an appropriate collection of arguments and evidence to justify the decision.

The safety analysis report (SAR) is central in the overall process. The SAR should provide an overall view of how the safety of the facility is arranged in order to protect human health and the environment against nuclear accidents. The report shall reflect the facility as built, analyzed and verified, as well as show how the requirements on its design, function, organization and activities are met. A preliminary safety report shall be complied before a facility may be constructed. The safety report shall be updated before trial operation of the facility may be started. The safety report shall be supplemented before the facility is subsequently taken into operation. The safety report shall subsequently be kept up-to-date.

In addition, and as appropriate, SSM examines the organizational, human and

administrative capacity to cary out works to the extent and the quality required as well as preliminary plans for decommissioning of the facility.

The step wise licensing process is schematically illustrated in figure A2 and summarized below.

Nuclear Legislative And Regulatory Framework - Licensing Process

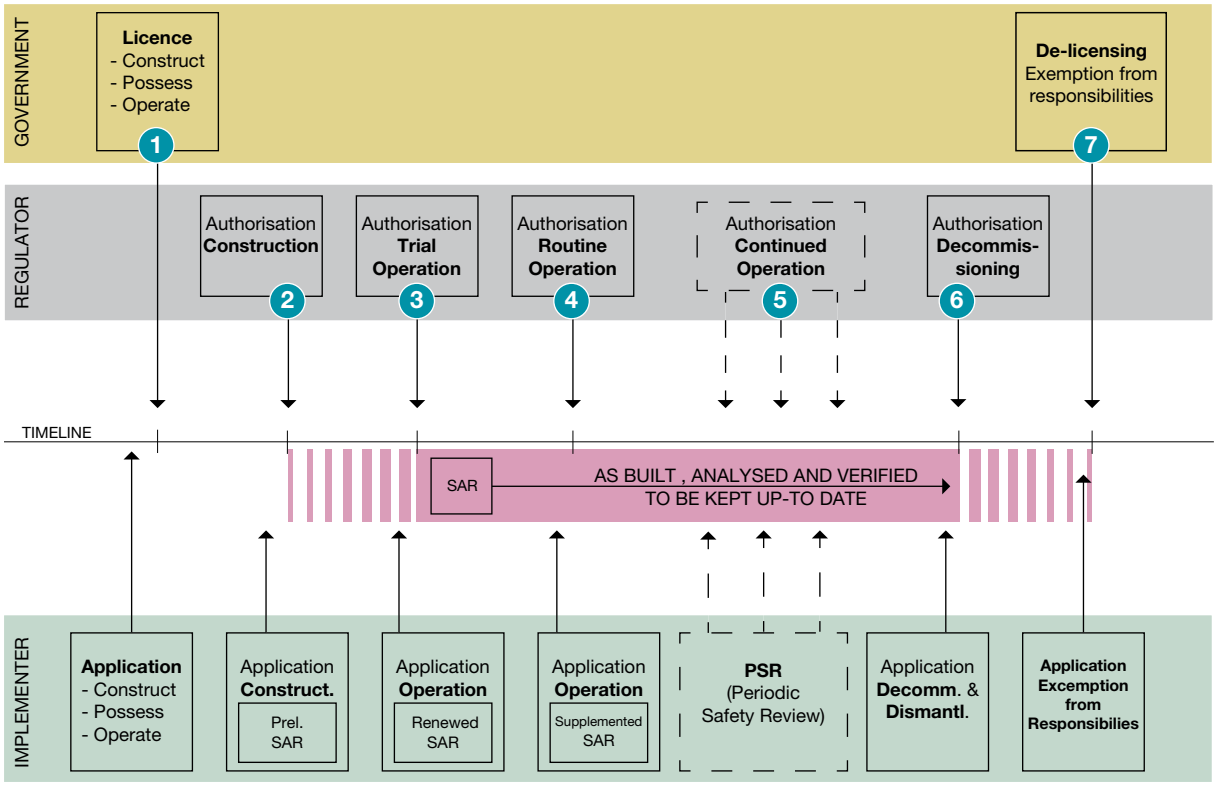


Figure A2: Licensing system basic principles

1. **Government license to construct, possess and operate (including decom missioning)**
   The license covers the lifecycle of the facility until the licensee is exempted from responsibilities as regards the facility/site. General obligations as regards management and disposal of spent nuclear fuel and nuclear waste remains until disposal facilities are sealed and closed. Review activities according to the Act on Nuclear Activities focus on feasibility to establish the activities and the facility at the proposed site. A parallel licensing process according to the Environmental Code focuses on permissibility and the site selection process.

2. **Regulatory authorization to start construction**
   The authorization is based on a regulatory review of the preliminary safety analysis report (PSAR). Review activities focus on that the preliminary design is compatible with legal and regulatory requirements and according to license conditions.

3. **Regulatory authorization to start trial operation**
   The authorization is based on a regulatory review of a renewed SAR. Review

activities focus on that the facility as built is in compliance with legal and regulatory requirements and according to license conditions.

4. **Regulatory authorization to start routine operation**
   The authorization is based on a regulatory review of a supplemented SAR taking into account the experience gained from trial operation. Review activities focus on experiences from the trial operation period and that the operation of the facility is in compliance with the operational Limits and Conditions (OLC) and according to license conditions.

5. **Periodic Safety Review (at least every ten years)**
   The authorization is based on a regulatory review an integrated analysis and overall assessment of the safety of the facility, concerning the way in which the facility at the time of analysis complies with the valid safety requirements as well as whether the necessary conditions exist to operate the facility in a safe manner until the next review occasion.

6. **Regulatory authorization to start decommissioning**
   The authorization is based on a regulatory review of that the decommissioning plan has been properly supplemented and incorporated into the facility's safety report.

7. **Exemption from responsibilities (for the facility) by the Government**
   The regulatory review focuses on verifying that the licensee has carried out all duties according to the legal and regulatory requirements and according license conditions. General responsibilities for management and disposal of spent nuclear fuel and nuclear waste remains until all spent fuel and waste is disposed of and disposal facilities are sealed and closed.

A.5.2.4 Basic requirements and general obligations

Another important element in the legal and regulatory framework is the general obligations in the Act on Nuclear Activities, requiring licence-holders for nuclear activities to ensure the safe handling and disposal of nuclear waste arising from the activities or nuclear material arising therein that is not reused. As regards spent nuclear fuel and nuclear waste, the licensee for a nuclear power reactor shall – in co-operation with the other holders of a licence for the operation of nuclear power reactors – establish and carry out a research and development (R&D) programme for the safe handling and disposal of spent fuel and nuclear waste (see also A.5.2.5)

As regards costs for management and disposal of spent nuclear fuel and nuclear waste, the licensee for a nuclear power reactor is – in co-operation with the other holders of a licence for the operation of nuclear power reactors – responsible for paying the costs for management and disposal of spent fuel and nuclear waste (see also A.5.2.6).

The licensee responsibilities are schematically illustrated in figure A3 and summarized below.

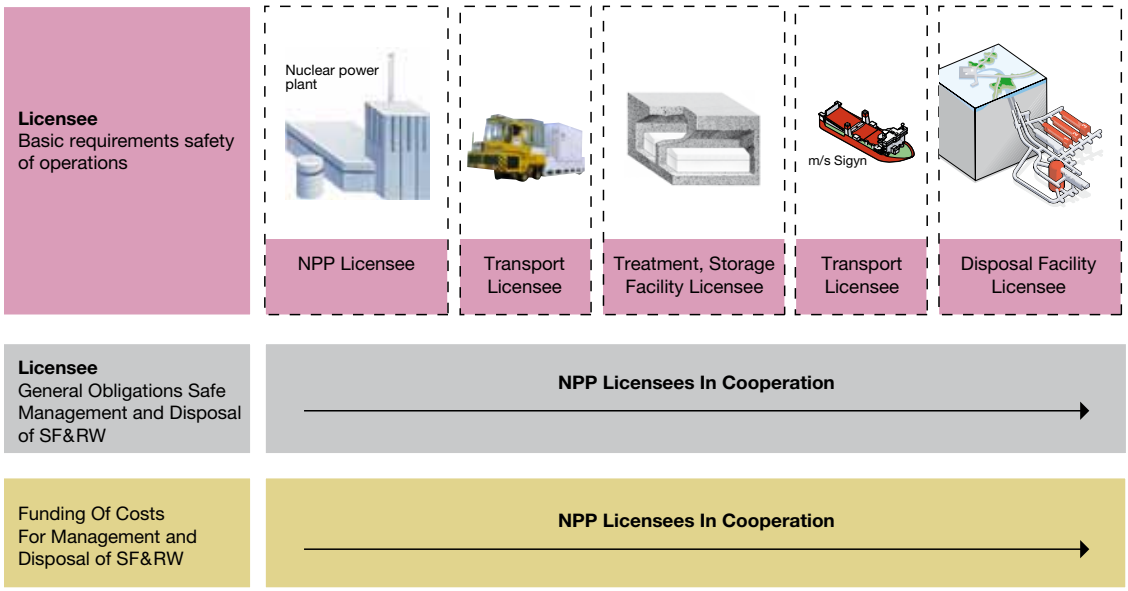


Figure A3: Licensee basic requirements and general obligations

Licensee is responsible for safe construction, operation and decommissioning – **facility perspective**

Licensees are also responsible for general obligations as regards management and disposal of spent nuclear fuel and nuclear waste – **management perspective, i.e.**

- NPP licensees must in co-operation develop and implement management and disposal solutions for spent fuel and nuclear waste.
- NPP licensees must in co-operation carry out cost estimates and invest money in Government controlled funds to cover future costs for dismantling of facilities as well as management and disposal of spent nuclear fuel and nuclear waste.

A.5.2.5 The research, development and demonstration programme (RD&D)

In the mid-1970's the Parliament promulgated the "Conditional Act", which required a government permit to load nuclear fuel into a new reactor. A permit could be issued if the utility presented either an agreement for reprocessing of the spent fuel, or a plan for the completely safe disposal of the high radioactive waste. This meant that direct disposal of the spent fuel could be accepted.

As a result of the "Conditional Act" the nuclear industry initiated a joint project on nuclear fuel safety (KBS). This included a wide-ranging programme of geological site surveys for the purpose of identifying suitable bedrock sites for the disposal of highly radioactive waste. The first summary report of the KBS project (KBS-l) was published in 1977. This described a method for the disposal of high-activity reprocessed vitrified waste. The report formed the basis for the subsequent permission (in 1979-1980) to load fuel into a number of reactors. A second summary report (KBS-2) dealing with the disposal of spent non-reprocessed nuclear fuel was issued in 1978. The work initiated by KBS continued on a long-term basis, and a completely revised version of the second report (KBS-3) was published in 1983.

The formal requirement for a RD&D-programme to be submitted for regulatory evaluation was established in 1984 when the Act on Nuclear Activities was promulgated. The Act requires a programme of comprehensive research and development and whatever other measures are needed to manage and dispose of spent nuclear fuel and nuclear waste in a safe manner and to decommission and dismantle the nuclear power plants, with focus on activities to be carried out within the next six years. Since 1986 the Swedish Nuclear Fuel and Waste Management Company (SKB) has produced nine RD&D programmes with KBS-3 as the main alternative for the disposal of spent fuel. The most recent programme was published in 2010. One of the main goals with the programme was fulfilled when a license application for a permit to build a disposal facility for spent nuclear fuel was submitted to the Swedish Radiation Safety Authority (SSM) and the Environmental Court on March 16th 2011. SKB is applying for permits to establish a spent nuclear fuel disposal facility in Forsmark and to establish an encapsulation plant in Oskarshamn. The RD&D programme continues in order to further investigate parameters relevant for a spent fuel disposal system. Decommissioning of nuclear facilities, extension and future operation of SFR and planning, development and research on a future disposal facility for long-lived radioactive waste (SFL) are also reasons to continue the RD&D programme.

A.5.2.6 The financing system to cover the costs for management and disposal

General

During the 1970's the nuclear power utilities established their own internal funds for future waste management expenses. These funds were transferred to a new financing system, under regulatory supervision, established in 1981 when the Swedish Parliament passed the Act on the Financing of Future Expenses for Spent Nuclear Fuel etc. Since 1981 the legislation has been revised a number of times, and various changes have been implemented. However, the basic principles have remained the same. The most recent commission of inquiry[1] on the financing system submitted its report to the Government in December 2004. As a result of the inquiry the Act (1992:1537) as well as the Ordinance (1981:671) on the Financing of Future Expenses on Spent Nuclear Fuel etc. was replaced by the Act (2006:647) and the Ordinance (2008:715) on Financial Measures for the Management of Residual Products from Nuclear Activities.

The main changes to the legislation are:

- A licensee has to submit cost estimates every three years. Previously the cost estimates had to be submitted by reactor owners on an annual basis.
- Also licensees other than licensees of nuclear power reactor must pay fees to the Nuclear Waste Fund.
- The licensee of a nuclear power reactor shall base costs estimates on 40 years of operation with a minimum remaining operating time of 6 years (previously the cost estimates were based on 25 years of operation).
- The licensee of nuclear facilities other than nuclear power reactors shall base cost estimates and the buildup of adequate financial resources on the expected remaining period of operation.
- Also the licensee of nuclear facilities other than nuclear power reactors shall provide a guarantee to cover the discrepancy between funded means and estimated costs.
- Extended liability for the nuclear industry. If there is insufficient money in the funds, the nuclear industry will still be liable.

The primary purpose of the Swedish financing system is to secure the financing of the licensees' costs to manage and dispose of the spent nuclear fuel and nuclear waste, decommission and dismantle the nuclear facilities and to carry out the needed research and development activities, but also to minimise the State's risk of being forced to bear the costs which is considered to be the licensee's liability.

Payments to the Fund

The licensee of a nuclear facility which generate or has generated residual products must pay a nuclear waste fee, to cover the licensee's share of the total costs.

[1] *As a consequence of the energy policy decision in 1997, which indicated that 2010 is no longer the final year for operation of Swedish nuclear power plants, a Governmental committee was appointed to review possible improvements to the financing system.*

For licensees, other than a licensee for a nuclear power reactor, it is possible to allow exemption to the obligation to pay a nuclear waste fee if the licensee provides a guarantee to cover its costs.
The licensee of a nuclear power reactor must pay a nuclear waste fee per delivered kilowatt-hour of electricity generated from nuclear power. The fees are paid to the Nuclear Waste Fund. SKB makes the annual cost estimates for all nuclear power utilities that form the basis for the regulatory authorities' review as well as the basis for calculating the fee.

The average fee is currently SEK 0.01 per kilowatt-hour (2010-2011) and is based on the assumption that each reactor will generate electricity for 40 years but with a minimum remaining operating time of 6 years.

Regulatory control
The regulatory authority appointed by the Government reviews the nuclear power utilities' cost estimates as well as the size of the guarantees that nuclear power utilities must make available. After its review, the authority submits a proposal for the size of the fees, and of the size of the guarantees required, to the Government. Based on this proposal, the Government sets the fees and guarantees. The fees are set for a three year period and are individual for each utility.

The management of the Nuclear Waste Fund is the responsibility of a separate government agency, the Nuclear Waste Fund.
The Swedish National Debt Office administrates and manages the guarantees.

Current cost estimates
The estimated total future cost, from 2012 onwards is approximately SEK 92 billion (equivalent to approx. €9,7 billion). The sum of the future expenses and of those already accrued on various nuclear waste projects, are approximately SEK 115 billion (equivalent to approx. €12,1 billion).

To date, the Nuclear Waste Fund has covered the expenses for:
- The Central Interim Storage for Spent Nuclear Fuel (Clab);
- the transport system, i.e., the ship Sigyn, containers, special trucks, etc;
- the Canister Laboratory, the Äspö Hard Rock Laboratory, the Bentonite Laboratory; and
- SKB's research and development costs, including siting activities.

The Nuclear Waste Fund will eventually cover expenses for:
- the encapsulation of spent nuclear fuel;
- the repositories for spent nuclear fuel and long-lived low and intermediate level waste;
- the decommissioning and dismantling of nuclear power plants;
- the disposal facility for decommissioning waste;
- continuing research and development work; and
- the expenses for regulatory control and supervision after closure of the reactors.

Costs for the management of operational waste are paid for directly by the nuclear power utilities. The disposal facility for radioactive operational waste (SFR) has therefore been paid for by the nuclear power utilities and not by the Fund.

Disbursements from the Fund

The licensees are entitled to disbursements, on a continuous basis, for expenses which they have already incurred for measures to achieve the decommissioning, handling and disposal of spent nuclear fuel and nuclear waste, including the research needed for these activities.

Municipalities where there are site investigations of the disposal facility for spent nuclear fuel, or where a facility for such a disposal facility is planned or being built, are entitled to compensation from the Nuclear Waste Fund for their information to the public. Disbursements may be determined to no more than 5 million per municipality and twelve-month period.

Also non-profit-making organisations are entitled to financial support, with a total amount of SEK 3 million per calendar year and limited to SEK 2,5 million per organisation.

The regulatory authority decides on the disbursement of funds to the nuclear licensees, the municipalities and the non-profit-making organisations.

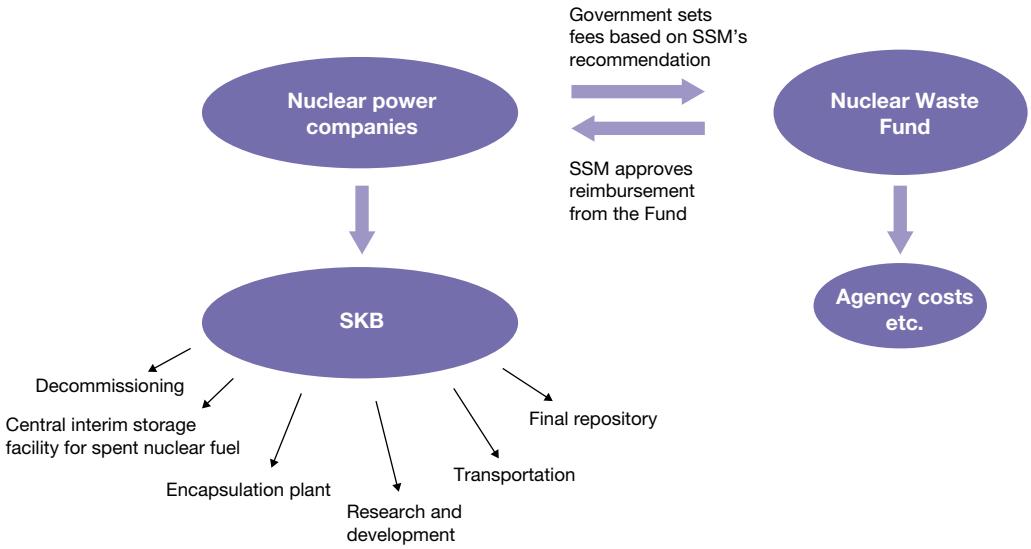


Figure A4: Flow of funds in the financing system as regards nuclear power utilities.

A.5.2.7 Costs for waste from past practices

As of 1989, a special fee has been levied on the nuclear power utilities according to a special law, the Act (1988:1597) on Financing of Certain Radioactive Waste etc. (the Studsvik Act). This fee is intended to cover expenses for the management of nuclear waste from older experimental facilities, in particular the facilities at Studsvik, the Ågesta reactor and the uranium mine in Ranstad, and for decommissioning and dismantling these facilities.

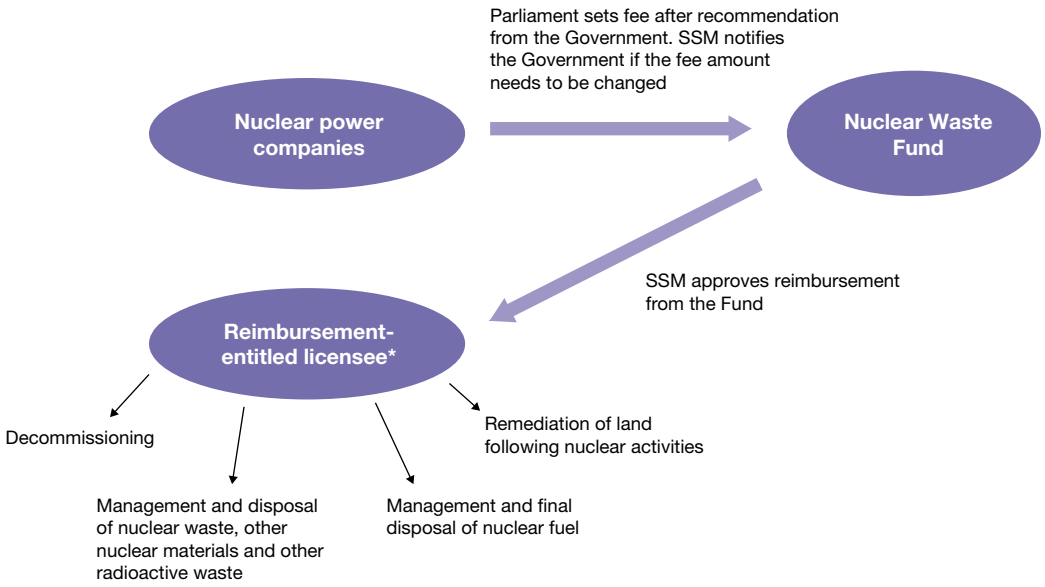
According to current cost estimates, SEK 1.8 billion (equivalent to approx. € 120 million) will be needed up to the year 2045 to meet these expenses. The special fee is the same for all operating nuclear power utilities, currently SEK 0.003 per kilowatt-hour, and is reassessed annually based on a proposal by SSM. These assets are administered together with the Nuclear Waste Fund.

In conjunction with the decision by the Swedish Parliament on new legislation for the financing of the license-holders general obligation according to the Act (1984:3) on Nuclear Activities, the Parliament also decided that the Studsvik Act should be cancelled by December 31, 2009. During the reassessment of the fee level in 2008 it became evident that remaining year of payments into the fund would not be sufficient to cover estimated costs. Therefore the Government decided to prolong the time period for contributions to the fund according to the Studsvik Act to January 1, 2012.

In 2009 the Government commissioned SSM to investigate future costs, uncertainties and responsibilities, and to evaluate in-depth the problems and financial risks that may arise if the Studsvik Act (1988:1597) was to expire on 1 January 2012. The mission also included, if the SSM found it appropriate, to propose constitutional amendments.

SSM submitted its report to Government in March 2010. The SSM assessment resulted in the conclusion that the combined impacts of the uncertainties, that have been identified, are expected to lead to a future need of funds higher than indicated in the current cost estimates. Furthermore, if the contributions to the fund according to the Studsvik Act would cease, the economic risk of the state would increase. The assessment of SSM is that the Studsvik Act should remain in force until further notice. If payments under this Act are to cease, the quality of the cost estimates must improve significantly.

The Government submitted a Bill (2010/2011: 126) to the Parliament in April 2011 containing a proposal to extend the obligation to pay the Studsvik fee to December 31, 2017. In June 2011 the Parliament approved the government bill and the reformed legislation will enter into force on 1 January 2012.



*Refers to licensees for facilities covered by the Studsvik Act. At present these are AB SVAFO, Studsvik Nuclear AB, Vattenfall AB (50% of the Ågesta CHP plant), Ranstad Industricentrum AB and Uppsala University.

Figure A5: Flow of funds according to the Studsvik Act.

A.5.3 Supplementary national planning for non-nuclear fuel cycle wastes

The Swedish Radiation Safety Authority[2] was assigned by the government to compile an integrated account for all spent nuclear fuel and radioactive waste generated both within and outside the nuclear fuel cycle, to identify and propose any improvement to the management and disposal activities. The assignment was reported back to the Government 30 June 2009.

The report confirms that management and disposal of spent nuclear fuel and nuclear waste (i.e. radioactive waste from the nuclear fuel cycle) is satisfactory. No specific action is needed in addition to already existing practices according to existing legal and regulatory framework, i.e. the Act (1984:3) on Nuclear Activities, the Act (2006:647) and the Ordinance (2008:715) on Financial Measures for the Management of Residual Products from Nuclear Activities and the Act (1988:1597) on Financing of Certain Radioactive Waste etc. (the Studsvik Act).

In order to improve the situation, the report proposes actions within the following areas:

- Interim storage and disposal of radioactive waste for radioactive waste generated outside the nuclear fuel cycle
- Action plans for radioactive material (outside the nuclear fuel cycle) which unintentionally ends up adrift without regulatory control
- Clarification of responsibilities in the legislation
- Preservation of information as regards waste disposal facilities

The report[3] can be downloaded from SSM's web site[4].

[2] The assignment was given to the Swedish Radiation Protection Authority (SSI) in 2008 and taken over by the Swedish Radiation Safety Authority (SSM) when established.
[3] Swedish national plan for the management of all radioactive waste, SSM Report 2009:29e
[4] www.ssm.se

A.6 The management system for spent nuclear fuel and nuclear waste

A.6.1 Generation of spent fuel and radioactive waste

Spent fuel in Sweden emanates mainly from four commercial nuclear power plants, one material testing reactor and one research reactor (see figure A6). The radioactive waste originates from the nuclear power industry as well as medical use, industry, research and consumer products. Past research activities have also generated some waste, which are either stored or have already been disposed of.

Under Swedish law, the holder of a licence to operate a nuclear facility is primarily responsible for the safe handling and disposal of spent nuclear fuel and radioactive waste, as well as decommissioning and dismantling of the facility. The four utilities operating nuclear power reactors in Sweden have formed a special company, the Swedish Nuclear Fuel and Waste Management Co. (SKB), to assist them in executing their responsibilities. Thus, SKB is responsible for all handling, transportation and storage of spent fuel and radioactive waste outside the nuclear power plants.

Furthermore, the company is responsible for the planning and construction of all facilities required for the management of spent nuclear fuel and radioactive wastes, and for such research and development work as is necessitated by the provision of such facilities (R&D programmes).These R&D programmes have to be reported to the Government, or an authority designated by the Government, and reviewed by the authorities every third year. The programme should include a comprehensive description of the measures taken to ensure safe handling and disposal of spent fuel and nuclear waste. SKB is further responsible for co-ordination and investigations regarding the costs associated with nuclear waste and future decommissioning.

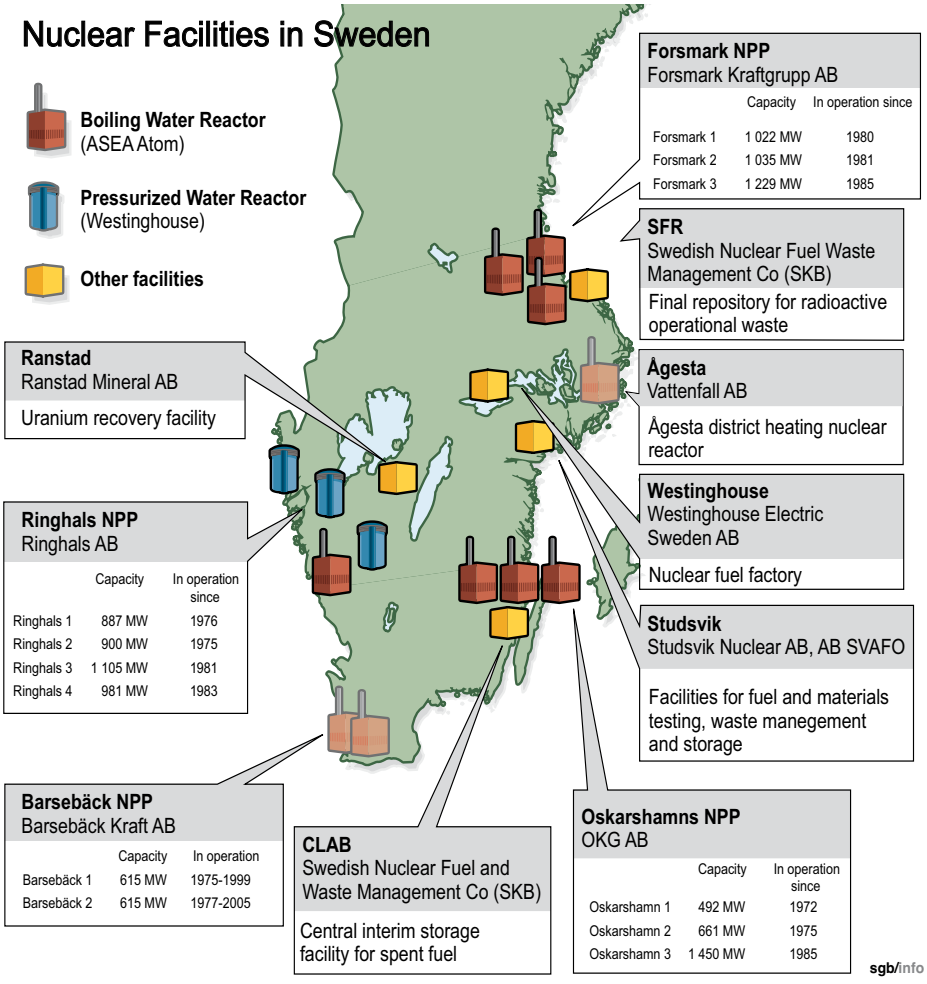


Figure A6: Nuclear facilities in Sweden.

A.6.2 System overview

Sweden has today 10 nuclear power reactors in operation at three sites giving rise to nuclear waste and spent nuclear fuel. In addition nuclear waste is produced at the Studsvik site (closed research reactor, hot-cell and waste treatment facilities) and, to a limited extent, at Westinghouse Electric Sweden AB's fuel fabrication plant.

In total the Swedish nuclear power programme will generate approximately 20 000 m^3 spent fuel, 60 000 m^3 low and intermediate level waste (LILW), and 150 000 m^3 decommissioning waste (based on 50-years operation of the reactors in Ringhals and Forsmark and 60 years operation for the reactors in Oskarshamn). The typical total annual production of LILW at the nuclear facilities is 1 000-1 500 m^3.

Spent nuclear fuel is transported to an interim storage facility (Clab). Radioactive operational waste from nuclear reactors, medical and research institutions and industrial radioactive waste is disposed of in an underground disposal facility in crystalline bedrock (SFR).

All transportation of spent nuclear fuel and nuclear waste is by sea, since all the nuclear facilities are situated on the coast. The transportation system has been in operation since 1982 and consists of the ship M/S Sigyn, transport casks and containers, and terminal vehicles for loading and unloading. M/S Sigyn will be replaced with a new ship in 2013.

Facilities that remain to be realised are an encapsulation plant for spent fuel and repositories for spent fuel, long-lived low and intermediate level waste, and for decommissioning waste. SKB:s R&D programmes are focused on these matters.

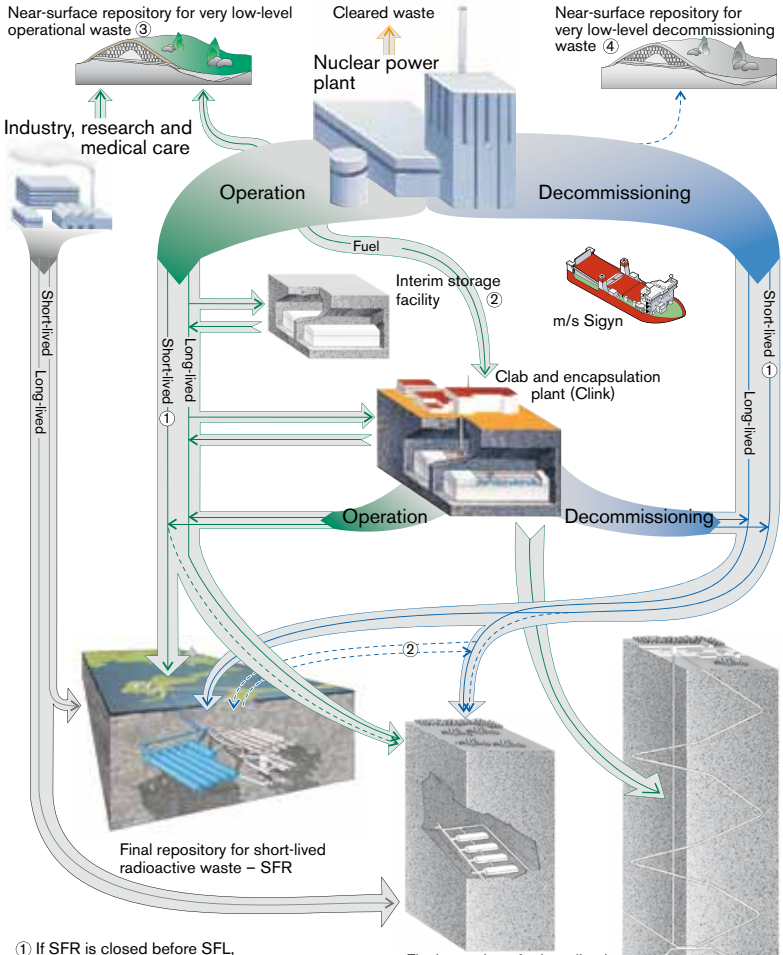


Figure A7: Management system for spent fuel and nuclear waste as presented in RD&D-programme 2010.

A.6.2.1 Existing Spent Nuclear Fuel Management Practices

Management practices at the NPP sites

Spent nuclear fuel from the nuclear power reactors is temporarily stored in water-filled fuel pools for at least nine months, before being transported to the central interim storage for spent nuclear fuel (Clab), where it will be stored for at least another 30 years before being encapsulated and deposited in a disposal facility.

The central interim storage for spent fuel, Clab

The spent nuclear fuel from all Swedish nuclear power reactors is stored in a central interim storage (Clab) situated adjacent to the Oskarshamn nuclear power plant. The facility consists of two parts, one building above ground for unloading spent fuel assemblies from transport casks, and one underground part for storage with a rock cover of about 25-30 meters. The storage part consists of two caverns approximately 120 metres long, each containing five storage pools.

Construction started in 1980 and the facility was taken into operation in 1985 with a storage capacity of 5 000 tonnes of spent fuel. The current total storage capacity is approximately 8 000 tonnes of spent fuel, and 5 222 tonnes were being stored at the end of 2010.

The facility is schematically illustrated in figure A8. Principal data as well as information on inventories are found in section D.1.2.3.

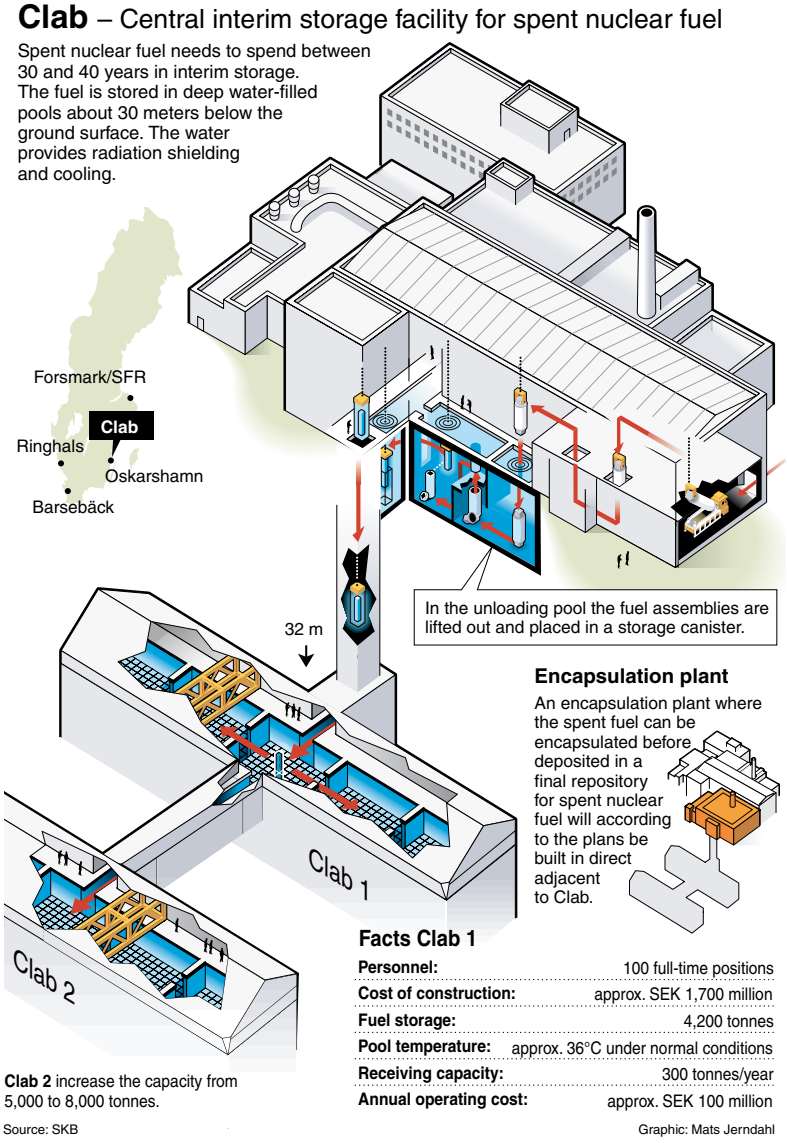


Figure A8: The Clab facility.

A.6.2.2 Existing Radioactive Waste Management Practices

Management practices at the nuclear sites

Most of the LILW are conditioned (solidified, compacted, etc.) at the point of origin, i.e. at the reactor sites. Some wastes are sent to Studsvik's waste treatment facilities for incineration or melting.

Disposal facility for radioactive operational waste, SFR

SFR is designed for the disposal of short-lived low and intermediate level radioactive waste from the Swedish nuclear power plants Clab, and for similar waste from other industry, research and medical usage. SFR is situated approximately 140 kilometers north of Stockholm, close to the Forsmark nuclear power plant. Approximately 25 people work at the facility.

SFR consists of four rock caverns and a silo. The facility is situated in crystalline bedrock, approximately 50 m below the seabed at a depth of 5 m. Construction started in 1983 and it was taken into operation in 1988. The total capacity is 63 000 m^3 and 33 871 m^3 had been used by 31 December, 2010.

The facility is schematically illustrated in figure A9. Principal data as well as information on inventories are found in section D.1.4.3.

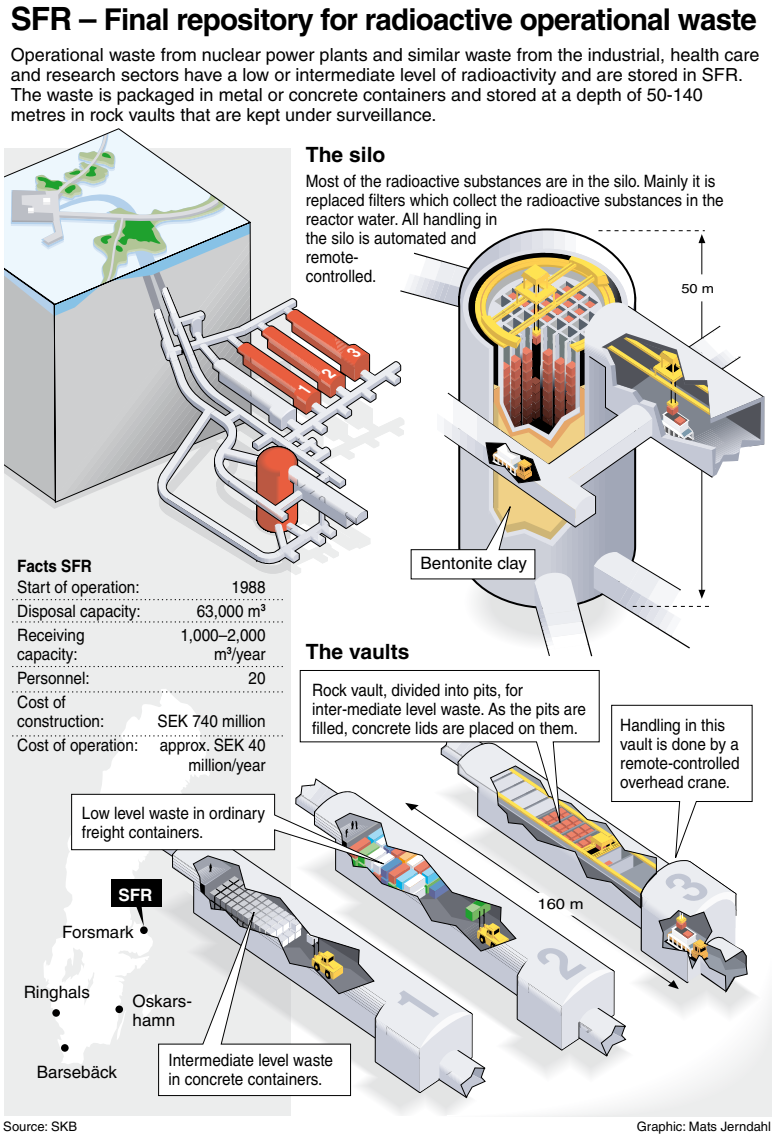


Figure A9: The SFR facility

SKB is planning an extension of SFR in order to dispose of additional operational waste and waste from future decommissioning of nuclear power plants. SKB intends to submit a license application in 2013 and operation is planned to commence in 2020.

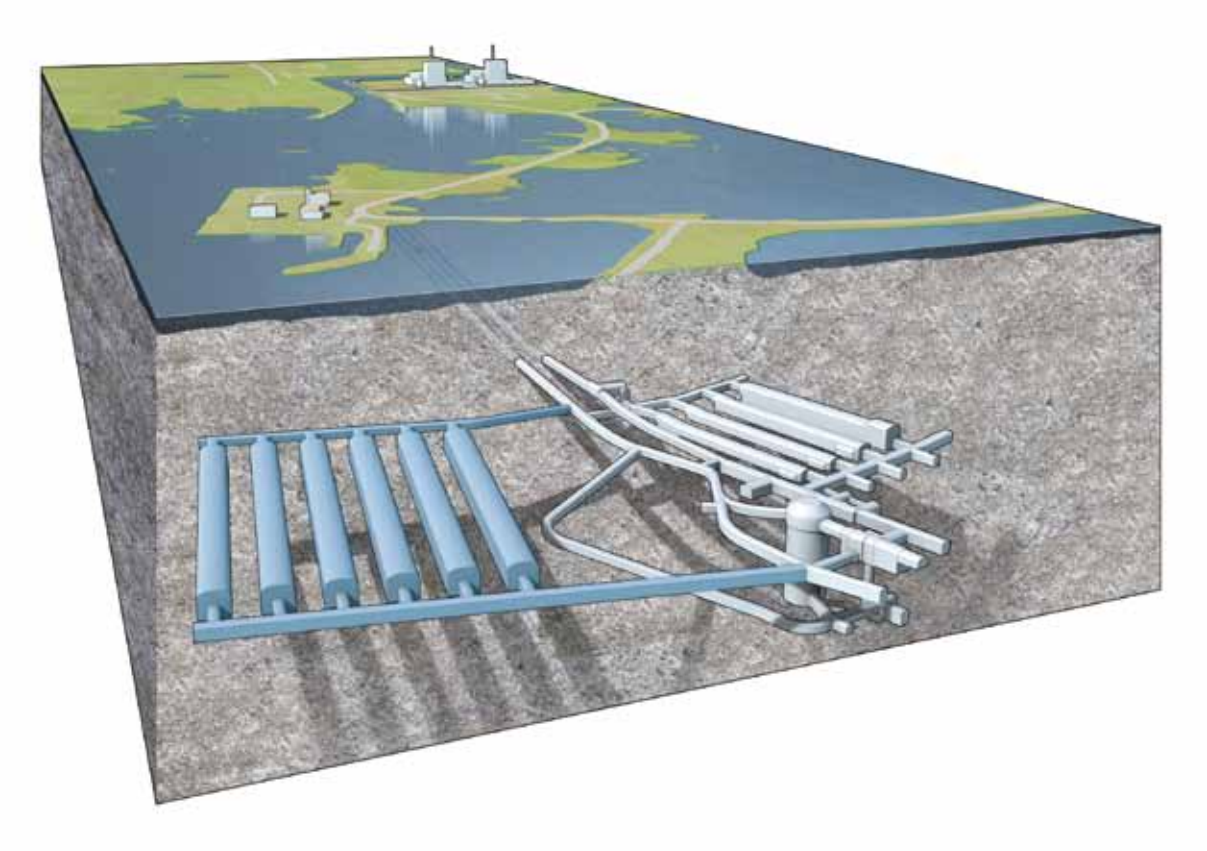


Figure A10: Planned extension of SFR (blue parts). The final design of the extension is not yet established.

Shallow land burials
The nuclear power plants at Ringhals, Forsmark and Oskarshamn as well as the Studsvik site have shallow land burials for solid short-lived low-level waste (<300 kBq/kg). Each burial is licensed for a total activity of 100 - 200 GBq (the highest level according to the legislation is 10 TBq, of which a maximum of 10 GBq may consist of alpha-active substances).

Clearance
Material may be cleared for unrestricted use or for disposal as conventional non-radioactive waste. For example in 2004 approximately 600 tonnes were cleared for disposal at municipal landfills. In addition 764 tonnes of melted metal (<500 Bq/kg) were cleared for recycling in 2010.

A.6.3 Planned facilities and siting

A.6.3.1 General

Four major facilities remain to be designed, sited, constructed and licensed; a plant for the encapsulation of spent nuclear fuel, a disposal facility for spent fuel, a disposal facility for long-lived low and intermediate level waste, and a disposal facility for waste from decommissioning and dismantling the nuclear power plants.

A.6.3.2 The Spent Nuclear Fuel Programme

The main alternative for disposal of spent fuel, KBS-3, involves emplacement of fuel elements in copper canisters (corrosion resistance) with cast iron inserts (mechanical strength). The canisters will be embedded in bentonite clay (protection against corrosion and rock movements, prevent water penetration and leakage of radioactive substances) in individual deposition holes at a depth of about 400-700 m in the bedrock (maintains the technical barriers over long time, isolates the spent fuel from human beings and the environment).

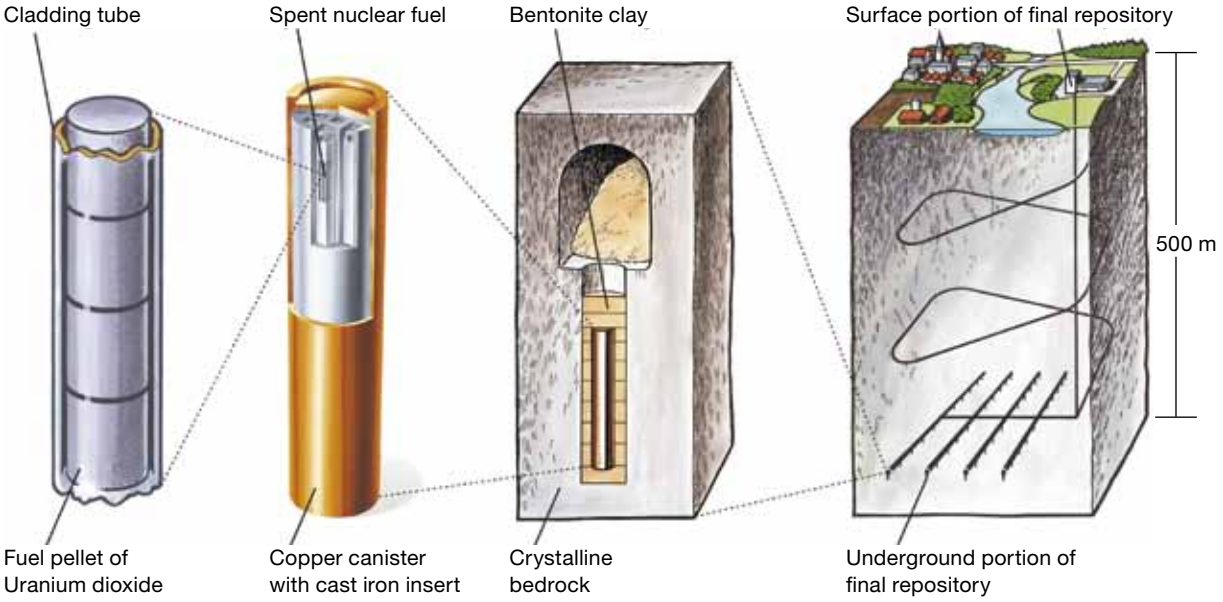


Figure A11: The reference method KBS-3 for disposal of spent nuclear fuel.

SKB's planning for the future management of spent nuclear fuel, from interim storage in Clab via encapsulation to disposal, takes place within the framework of SKB's Nuclear Fuel Programme. The programme includes licensing, design, construction and commissioning of the encapsulation plant and the disposal facility for spent nuclear fuel.

On March 16, 2011, SKB's applications for a permit to build a disposal facility system were submitted to the Swedish Radiation Safety Authority (SSM) and the Environmental Court in Stockholm. The company is applying for a permit to build a nuclear fuel disposal facility in Forsmark and an encapsulation plant in Oskarshamn. SKB also has to apply for a new permit for the Interim storage facility for spent nuclear fuel (Clab) in accordance with Sweden's Environmental Code.

Encapsulation plant for spent nuclear fuel

The encapsulation plant will be built directly adjacent to Clab. Prior to operation the facilities will be interconnected to a single unit, called Clink. Their operation will then be integrated. Figure A12 illustrates the handling sequence for the fuel, from the storage pools in Clab via encapsulation to delivery of the filled and sealed canister.

An application under the Act (1984:3) on Nuclear Activities for a licence to build the encapsulation plant and a licence to own and operate it as an integrated facility with Clab was submitted in 2006. Supplements were promised in the application and in 2007, after the initial review, SKB received a number of demands for supplementary information. SKB has responded to these demands, and a supplement was submitted in 2009.

The time schedule for encapsulation of the spent nuclear fuel has been developed by SKB, and the following sequence of events is proposed (see also figure A13):

2010-2016	Examination of application including review of SSM and Envi ronmental court, government decision and finalisation of PSAR
2016-2025	Construction and commissioning
2024	Submission of application for trial operation
2025-2026	Trial operation
2026	Submission of application for operation
2027	Operation

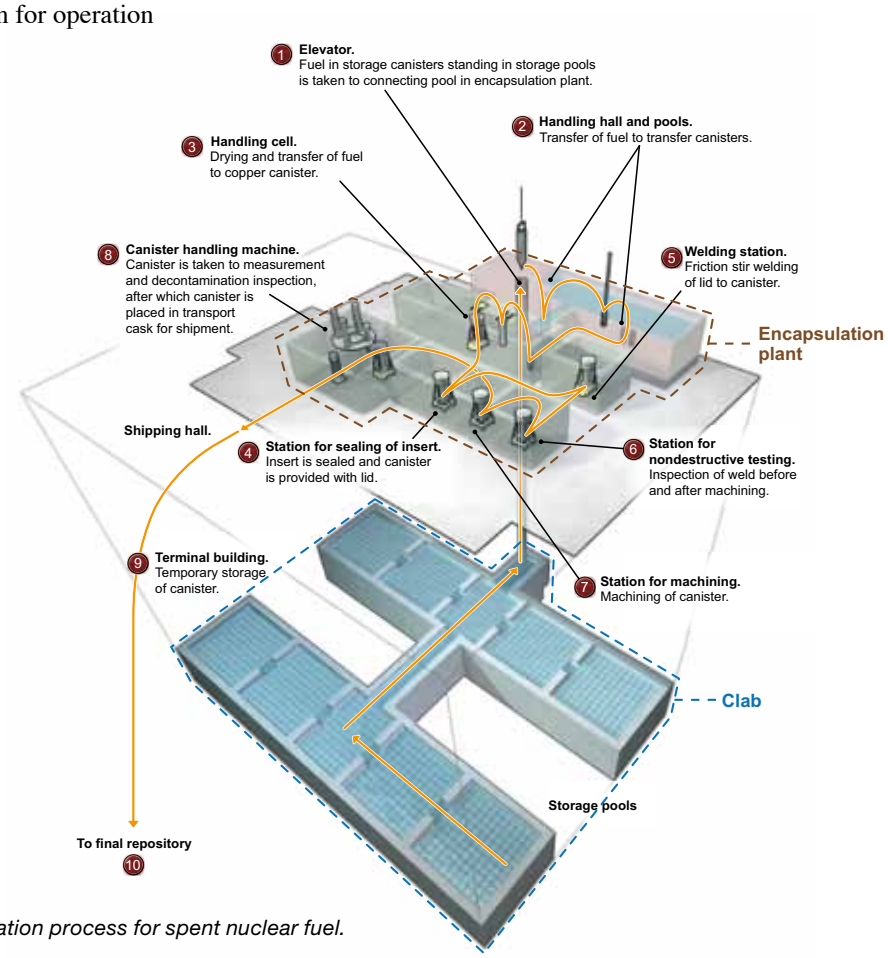


Figure A12: The encapsulation process for spent nuclear fuel.

Disposal facility for spent nuclear fuel

In the early 1990's SKB initiated a programme for siting a spent nuclear fuel disposal facility. SKB's time schedule for performed and coming activities for the disposal of the spent nuclear fuel is (see also figure A7):

2005-2009	Site investigations at two sites: Laxemar (Oskarshamn municipality) and Forsmark (Östhammar municipality).
June 2009	SKB selected Forsmark as the site for a disposal facility for spent nuclear fuel
2011	SKB submitted license applications for siting and construction of the facility
2011-2015	Examination of application including review of SSM and Envi ronmental court, government decision and finalization of PSAR
2015-2025	Construction and commissioning
2024	Submission of application for trial operation
2025-2026	Trial operation
2026	Submission of application for operation
2027	Operation

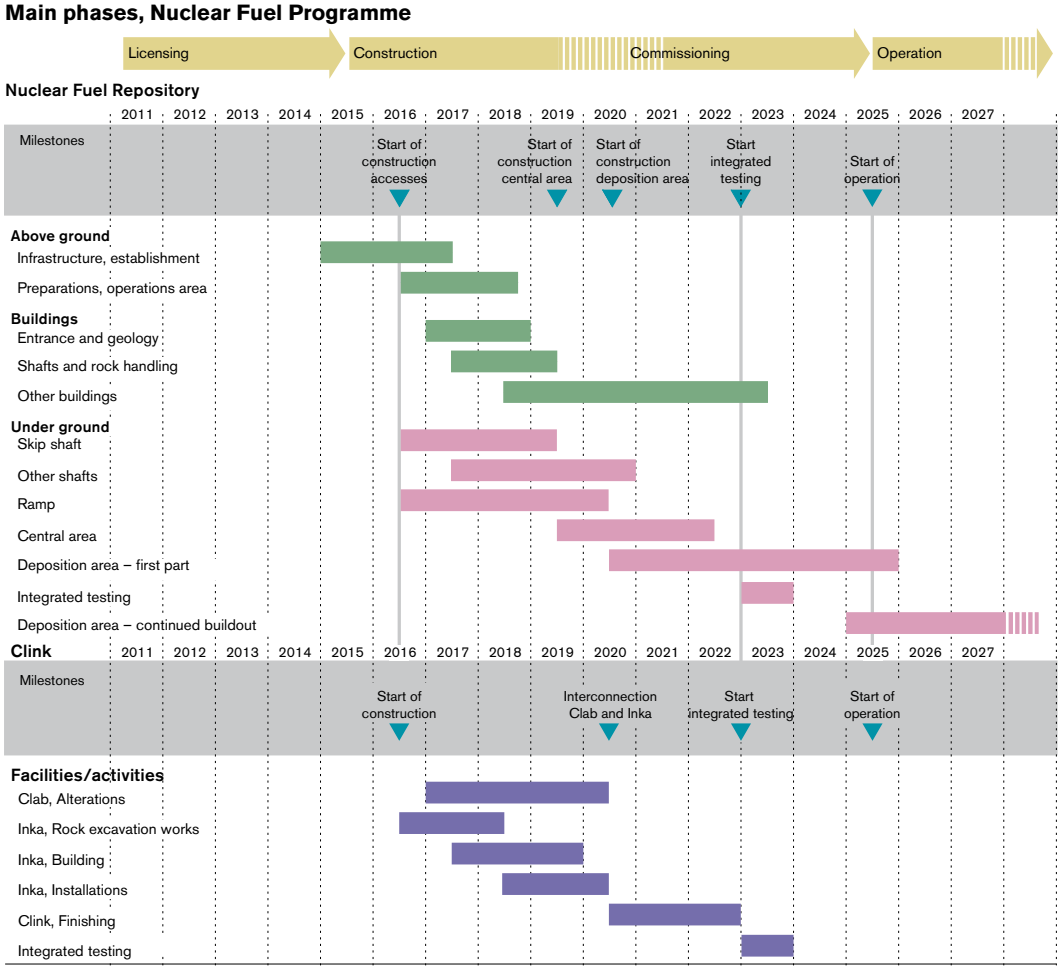


Figure A13: Time table for establishment of the spent fuel disposal facility and Clink.

Research and demonstration facilities

The Äspö Hard Rock Laboratory

The Äspö Hard Rock Laboratory (HRL), which was built during the period 1990–1995, is situated on Äspö north of the Oskarshamn Nuclear Power Plant. The underground laboratory consists of a tunnel from the Simpevarp Peninsula, where the Oskarshamn nuclear power plant is located, to the southern part of Äspö. On Äspö the main tunnel descends in two spiral turns to a depth of 460 metres. The various experiments are conducted in niches in the short tunnels that branch out from the main tunnel. An illustration of the HRL is shown in Figure A14.

The laboratory is used to investigate how the barriers in the disposal facility for spent nuclear fuel (canister, buffer, backfill, closure and rock) prevent the radionuclides in the fuel from reaching the ground surface.

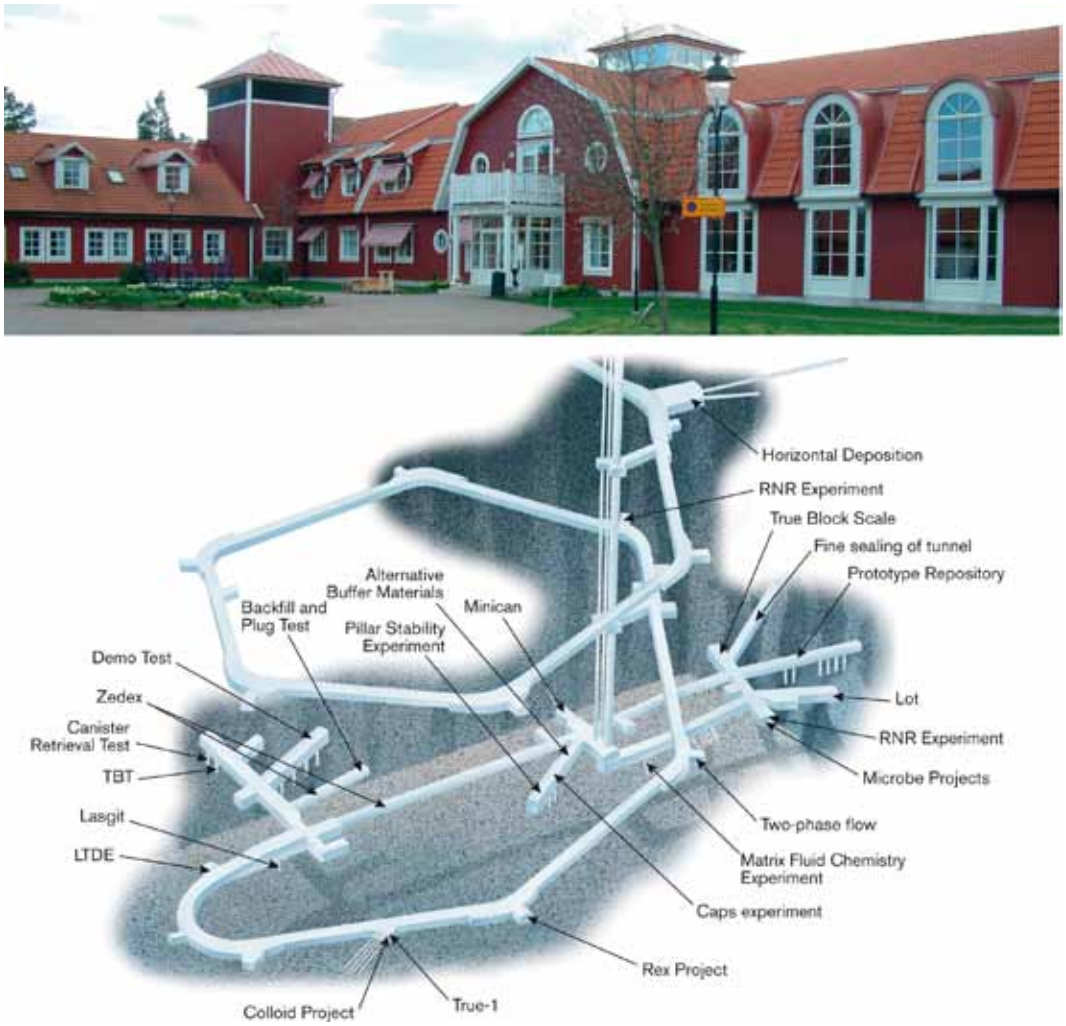


Figure A14: The Äspö Hard Rock Laboratory.

The Canister Laboratory
The Canister Laboratory, situated in the harbour area at Oskarshamn, was built during the period 1996–1998. One of the shipyard's old welding halls has been converted for use in the development of the sealing technology for copper canisters. It is mainly equipment for welding of copper lids and bottoms and for nondestructive testing of the welds and the different parts of the canister that is developed there. But equipment and systems for handling spent nuclear fuel and canisters are also tested and developed in the laboratory. The facility will also be used for training of personnel in preparation for the commissioning of the encapsulation line in Clink. The Canister Laboratory is therefore planned to be in use until encapsulation of the spent nuclear fuel commences.
There are stations in the Canister Laboratory for testing different welding techniques and different methods for nondestructive testing. The goal is to develop methods that meet the stipulated quality requirements and have sufficiently high reliability to be used in Clink. The most important items of equipment in the laboratory are a friction welder, an electron beam welder, and equipment for radiographic and ultrasonic testing.

Figure A15: The Canister Laboratory´s equipment for development of friction stir welding.

The Bentonite Laboratory
SKB has been conducting research and development in the Bentonite Laboratory in Oskarshamn since 2007. The facility is situated adjacent to the Äspö HRL and supplements the experiments being conducted there.
In the Bentonite Laboratory the properties of the bentonite is tested by, for example, simulating water conditions in a controlled manner. Here SKB is also developing methods for backfilling the disposal facility's tunnels and building plugs to seal the deposition tunnels.

Figure A16: Stacking tests performed at the Bentonite Laboratory on Äspö.

A.6.3.3 The Low- and Intermediate Level Waste (LILW) Programme

Disposal facility for short-lived low and intermediate level decommissioning waste (SFR)
SKB plans to dispose of waste from the future decommissioning of the nuclear power plants in an extension to SFR. The planned extension entails an increase of the facility's storage capacity by an estimated 140,000 m^3 from today's capacity of 63 000 m^3. SKB intends to submit a license application in 2013 and operation is planned to commence in 2020.

Disposal facility for long-lived low and intermediate level waste (SFL)
According to current plans, a license application to build a disposal facility for long-lived low and intermediate level waste (SFL) will be submitted in 2030 and operation is planned to commence in 2045. The origin of this waste is primarily research, industry, medical applications, core-components and certain internal components from nuclear power reactors. The waste is currently stored at Studsvik, the nuclear power plants and Clab. The volume of SFL will be relatively small compared to SKB's other disposal facilities. The total storage volume is estimated to 10 000m^3.

Dry interim storage of long-lived waste
Earlier plans of interim storage in BFA (rock cavern for waste) of long-lived low- and intermediate-level waste from all nuclear power plants have changed. Instead, SKB is investigating the possibility to establish an interim storage of long-lived waste in the extended SFR. A decision regarding interim storage in SFR will be taken before the design of the extension has been established.
A new waste container, called ATB 1T, will be developed in order to transport the long-lived low- and intermediate level waste. Delivery of the container is expected in 2015.

Main milestones for the LILW-programme

2013	Application for extension of SFR to accommodate decommissioning waste
2013	Concept study for SFL to be finalized
2017	Start of construction works for extension of SFR
2020	Start of operation extended SFR
2035	Start of construction works to establish SFL
2045	Start of operation of SFL

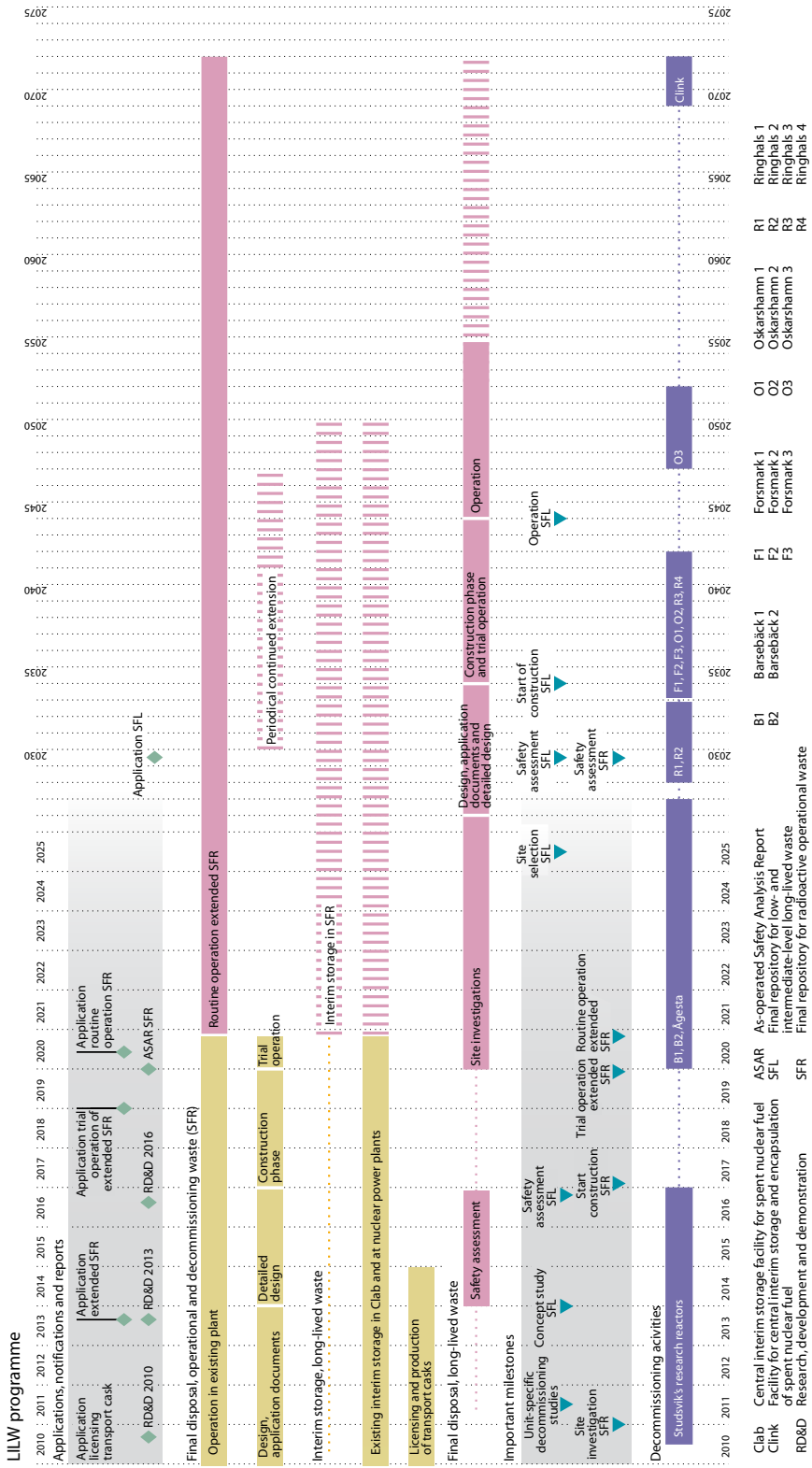


Figure A17: Time table for the LILW programme.

A.7 Swedish participation in international activities to enhance safety and radiation protection

A.7.1 The regulatory authority

The international nuclear safety cooperation is substantial; SSM is involved in about 150 international groups. The majority of groups are related to nuclear safety and radiation protection issues. The cooperation takes place within the frameworks of IAEA, OECD/NEA and EU, but also in connection with the international conventions ratified by Sweden and in non-governmental organizations such as the Western European Nuclear Regulators' Association (WENRA), Heads of European Radiation Control Authorities (HERCA), and the International Nuclear Regulators' Association (INRA).

In addition to multilateral collaboration, SSM has bilateral agreements with nine countries to exchange information and to cooperate on agreed issues (e.g. nuclear safety, emergency preparedness, occupational exposure, environmental radiological protection and radioactive waste management). These are Australia, Canada, Germany, Japan, Lithuania Ukraine, Russia, South Africa, and USA. Additionally Sweden has special agreements with the Nordic Countries (Denmark, Finland, Iceland and Norway) regarding emergency preparedness and information exchange on the technical design of nuclear facilities.

SSM contributed significantly to WENRA's benchmarking project which made a systematic comparison of national reactor safety requirements and their implementation against jointly agreed reference levels[5]. SSM participates actively in ENSREG (European Nuclear Safety Regulators' Group), an expert body of senior officials from national regulatory or nuclear safety authorities from all 27 EU member states. Through ENSREG and its working groups SSM has been active in the preparations for the directives on establishing a Community framework for the nuclear safety of nuclear installations (2009/71/EURATOM) and a Community framework for the responsible and safe management of spent fuel and radioactive waste (2011/70/EURATOM).

SSM was active in the work of the International Commission on Radiological Protection (ICRP); both chair and secretary were until recently from Sweden. SSM contributes to the work performed within the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and The Helsinki Commission (HELCOM) conventions for reduction of releases of radioactive substances from nuclear facilities. SSM takes active part in the development of new international safety standards for protection against harmful effects of ionising radiation. This work has been performed directly (Euratom BSS Directive) and via NEA and IAEA (International BSS).

Apart from the regulatory issues, SSM is engaged in research projects, mostly within the co-operation of the EU research programme, NEA and IAEA. Sweden is active in networks for research and cooperation in radiobiology, radioecology and biological dosimetry. The SSM is involved in many international expert missions; for example as experts in IAEA review service teams.

[5] *Report by the WENRA Reactor Harmonisation Working Group, January 2006 and WENRA Reactor Safety Reference Levels, January 2008 are available at: www.wenra.org.*

SSM constantly prioritise its international engagement and work due to limited staff resources. A classification system of the different international work has been introduced and a policy for international work has been developed as part of the SSM integrated, process-based management system.

A.7.2 SSM's international support programmes

Swedish authorities have since 1992 been engaged in providing assistance to states of the former Soviet Union in the area of nuclear safety and security as well as radiation protection. Since 2008, this work is carried out by the Swedish radiation Safety Authority, SSM, The aims of the bilateral assistance are:

- to improve reactor safety and minimise the risk of a nuclear accident with uncontrolled radioactive releases at the facilities in question;
- to improve conditions so that radioactive waste, including spent nuclear fuel, shall be handled and stored in a manner that is acceptable from the point of view of safety and radiation protection, regarding personnel, the public and environment;
- to impede the mismanagement of nuclear and radioactive materials and to strengthen the non-proliferation measures and institutions
- to improve the national preparedness and awareness as concern radiation protection for people and the environment.
- to strengthen the legislation and exercising of authority in connection with nuclear facilities and handling of radioactive waste; and
- to contribute to the development and strengthening of the countries' authorities and organisations within the national emergency preparedness and to establish co-operation in the event of an emergency situation in the Baltic region.

Currently the cooperation partners for Sweden are: Russia, Ukraine, Moldova and Georgia. Earlier on, Sweden has had similar cooperation programmes with Armenia, Kazakhstan, Belarus, Eastonia, Latvia and Lithuania. In 2010, the funding allocated by the Swedish Government for these purposes amounted to 7 million Euro.

A.7.3 SKB

In being the responsible entity for all handling, transportation and storage of spent nuclear fuel and radioactive wastes outside the Swedish nuclear power plants, SKB gives international co-operation high priority, and works together with corresponding organizations in i.e. Canada, Finland, Germany, Japan, Spain, Switzerland, United Kingdom and USA.

The main aim for SKB's international activities is to follow the research and development work conducted in other countries and to participate in international projects within the field of nuclear waste management. Furthermore, the international work provides perspective to the domestic programme and contributes to maintaining state-of-the art competence in relevant scientific areas.

SKB actively participates in several IAEA, EU and OECD/NEA committees and working groups. SKB is also engaged in a large number of research projects within these international organizations. SKB also runs the Secretariat of the "Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP)

in which eleven waste management organizations co-operate. SKB is currently participating in the 7th Framework Programme and has actively proposed areas for future research and development in the 8th Framework Programme.

The cooperation with Posiva in Finland is the most extensive and comprises projects in the fields of disposal facility technology, site investigation and encapsulation techniques.

One important example of SKB's international research co-operation is the Äspö Hard Rock Laboratory, where organizations from i.e. Finland, France, Germany, Japan, Spain, Switzerland, Canada and the Czech Republic are (or have been) carrying out joint studies.

B.1 Article 32.1: REPORTING

1. In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:
(i) spent fuel management policy;
(ii) spent fuel management practices;
(iii) radioactive waste management policy; (iv) radioactive waste management practices
(v) criteria used to define and categorize radioactive waste.

The present report constitutes the fourth Swedish report issued in compliance with Article 32.

B.1.1 Spent fuel management policy

The Swedish spent fuel policy is not explicitly expressed in single document. The rationales for the management system for spent fuel and nuclear waste are based on basic principles that have been derived from extensive discussions in the Swedish parliament.

Thus, the national policy and strategy for the management of spent nuclear fuel and nuclear waste has been expressed and supported by the parliament by means of four basic principles:

1. The expenses for the disposal of spent nuclear fuel and nuclear waste are to be covered by revenues from the production of energy that has resulted in these expenses.
2. The reactor owners are to safely dispose of spent nuclear fuel and nuclear waste.
3. The state has the ultimate responsibility for spent nuclear fuel and nuclear waste. The long-term responsibility for the handling and disposal of spent nuclear fuel and nuclear waste should rest with the state. After a repository has been closed, a requirement should be established to ensure that some kind of responsibility for and supervision of the repository can be made and maintained for a considerable time. A government authority could assume responsibility for a closed repository.
4. Each country is to be responsible for the spent nuclear fuel and nuclear waste generated in that country. The disposal of spent nuclear fuel and nuclear waste from nuclear activities in another country may not occur in Sweden other than in an exceptional case.

Another basic prerequisite as regards spent fuel management is that reprocessing will not take place. Thus, spent nuclear fuel is in practice considered as, and treated as, waste, although it is not legally defined as waste until disposed of in a repository.

B.1.2 Spent fuel management practices

At the nuclear power plants, the spent nuclear fuel is stored in the fuel pools for about a year before it is transported to the central interim storage facility for spent nuclear fuel (Clab). The safety and security measures taken at the NPPs do not differentiate between spent or partially spent fuel. The process of loading spent fuel into transport containers (weight: 80 tonnes, thickness: 32 cm of steel, length: 6.15 m, diameter: 1.95 m, capacity: 17 BWR-elements or 7 PWR-elements) is closely monitored and carefully performed in order to guarantee a contamination-free surface of the container. Special procedures are rigorously followed to achieve the desired quality control. Spent nuclear fuel from the Forsmark NPP and the Ringhals NPP (and previously the Barsebäck NPP), is transported with specially designed transport vehicles to the site harbors and shipped to the central storage for spent nuclear fuel in Oskarshamn. Spent nuclear fuel from the Oskarshamn NPP is transported directly to Clab by means of specially designed transport vehicles.

SSM supervises the management of spent nuclear fuel at the NPPs during the ordinary inspections of safety and security. These procedures fall under the general management of safety. The issues of contamination of spent nuclear fuel containers, however, were/are the responsibility of radiation protection and transport safety.

The capacity of the interim storage for spent nuclear fuel (Clab) was increased in 2008 and the storage capacity is now sufficient to provide for storage of all spent fuel to be produced in Swedish NPP's, i.e. 50-years operation of the reactors in Ringhals and Forsmark and 60 years operation for the reactors in Oskarshamn.

According to current plans, fuel elements after a storage period in Clab of about 30-40 years will be transported to the spent nuclear fuel disposal facility. Prior to this they will be placed in a cast iron insert in a copper canister. In the disposal facility they will be surrounded by a buffer of bentonite clay, and deposited in individual vertical bore holes in crystalline bedrock at a depth of 400-700 meters.

The siting process for the disposal facility ended in June 2009, as described in the introduction in section A, when the board of SKB decided to choose Forsmark as the site for the disposal facility for spent nuclear fuel. In March 2011 SKB submitted a license application for siting and construction of the disposal facility, which is expected to commence operation in 2025.

B.1.3 Radioactive waste management policy

As is the case for management of spent fuel, the Swedish spent fuel policy is not explicitly expressed in single document. The Swedish Parliament has on several occasions declared that Sweden supports and will follow the principle of each country's responsibility to take care of and dispose of radioactive waste produced within the country. Disposal, as well as interim storage, of foreign radioactive waste in Sweden is prohibited.

B.1.4 Radioactive waste management practices

Very low level short-lived waste (VLLW) may be:

- disposed of in shallow land burials that are licensed according to the Act on Nuclear Activities; or
- subject to clearance according to the regulatory authority's requirements and decisions, and either
- released for unrestricted use;
- disposed of in municipal landfills; or
- incinerated using specific furnaces (only applicable on contaminated oil).

Short-lived LILW is treated and packaged according to a standardized system with predefined waste type descriptions (WTD) and disposed of in the disposal facility for operational waste (SFR), in rock caverns in crystalline bedrock. WTD's are subject to approval by the regulatory authority. The disposal facility consists of five different caverns, and wastes are directed to different parts of the disposal facility depending on, e.g. the activity content and chemical characteristics.

Long-lived LILW will be disposed of in a disposal facility in rock caverns in crystalline bedrock. Until the disposal facility has been constructed the long-lived waste will be stored either at the NPP, at the Studsvik site or in storage pools in the interim storage for spent nuclear fuel (Clab). However, SKB investigates the possibility to establish an interim storage of long-lived low- and intermediate level waste in the extended SFR. A decision regarding interim storage in SFR will be taken before the design of the extension has been established.

Waste arising outside of the nuclear fuel cycle may – when needed and if appropriate – be disposed in disposal facilities for nuclear fuel cycle wastes.

B.1.5 Criteria to define and categorize radioactive waste

B.1.5.1 Definitions

The definition of nuclear waste according to the Act (1984:3) on Nuclear Activities is:

- spent nuclear fuel that has been placed in a disposal facility,
- a radioactive substance formed in a nuclear plant and which has not been produced or removed from the plant to be used for education or research, or for medical, agricultural or commercial purposes,
- materials, or other items, that have belonged to a nuclear plant and become contaminated with radioactivity, and are no longer to be used in that plant, or
- radioactive parts of a nuclear plant that is being decommissioned.

In the Radiation Protection Act (1988:220) the term "radioactive waste" is used. The term includes radioactive waste from nuclear activities, as well as from non-nuclear activities (medical use, use of sealed sources, research institutions, consumer products, etc). The legal definitions are discussed further in section E.2.1, and section D, in which the disposal routes for different waste streams are presented.

B.1.5.2 Categorisation

There is no legally defined waste classification system in Sweden for nuclear or radioactive waste. There are, however, established waste acceptance criteria for different disposal routes of nuclear and radioactive waste. These disposal routes differ between activities within the nuclear fuel cycle and outside the nuclear fuel cycle depending both on the different types of material being handled and also on which of the different routes that have been established by taking repositories into operation. For the established disposal routes, including clearance, waste acceptance criteria have been set up, expressed as dose rate limits and activity concentration.

Criteria for waste being disposed as very low-level waste (VLLW) at shallow land burials are given in section D.1.4.4.

Criteria for low and intermediate level waste being disposed in the repository for radioactive operational waste (SFR), are given in section D.1.4.3. A separate permit is needed for each category of waste before disposal is allowed. The permit is based on a waste type description (WTD) comprising detailed specifications on waste treatment, composition and conditioning, etc. Furthermore, for each subsystem, such as the different rock caverns of the SFR facility, dose rate criteria have been established. In addition, total dose and/or nuclide specific activity limits have also been established for the different disposal facilities as a whole or for each section of the facility.

Thus, a tailor-made management system for production and disposal of waste packages has been developed. Waste categorization is strictly operational and depends on the origin of the waste and of the disposal facilities. Waste packages are produced according to detailed specifications in the WTD's. These are developed in close co-operation between the waste producer (the NPPs) and the repository licensee (SKB). Treatment and conditioning at the NPPs, is governed by the management systems at the NPPs and subject to the general regulations and requirements for quality assurance. This is also the case for handling and disposal at SFR. All documentation concerning a single waste package is documented locally in databases at the producers. Basic information concerning a package has to be transferred to a waste database at the repository before a waste package may be transported to SFR. The system checks the incoming information to make sure criteria from the WTD's are fulfilled, and that the package is suitable for emplacing in the predestined part of the repository. After transportation to SFR all documentation is transferred to the database in order to store the information for the time needed.

It is of course possible to classify waste according to any standard based on this procedure since each available or planned disposal option corresponds to different classes of, e.g. the IAEA classification standards.

C.1 Article 3: SCOPE OF APPLICATION

- This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.
- This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.
- This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defence programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.

C.1.1 Reprocessing and military or defence programmes

Reprocessing is not part of the nuclear fuel cycle in Sweden. There is no reprocessing facility in Sweden and spent fuel from nuclear power reactors is not sent for reprocessing in other countries. Reprocessing agreements were made with United Kingdom Atomic Energy Agency (now the British Nuclear Fuel Limited, BNFL) in 1969 and Compagnie Générale des Matières Nucléaires (COGEMA) for reprocessing spent nuclear fuel from civilian nuclear power plants. Only a small number of fuel elements were in fact shipped for reprocessing and the agreements were terminated in the early 1980's. These past practices are also discussed in Section A.5.1.

Sweden terminated all research activities related to military or defence programmes in 1970, and all radioactive residues from activities involving nuclear technology are since then part of the civilian sector. Radioactive waste from research activities related to military or defence programmes, before 1970, has been permanently transferred to the management programme for civilian radioactive waste. These past practices are also discussed in Section A.5.1.
Sweden declares all spent fuel and all radioactive waste originating from the nuclear fuel cycle for the purpose of the Joint Convention, pursuant to Article 3, paragraph 1 and 3.

C.1.2 Naturally occurring radioactive materials

Sweden does not declare waste that contains only naturally occurring radioactive material and that does not originate from the nuclear fuel cycle as radioactive waste for the purpose of the Joint Convention, pursuant to Article 3, paragraph 2.

D.1 Article 32.2: REPORTING

2. This report shall also include:
(i) a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;
(ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;
(iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;
(iv) an inventory of radioactive waste that is subject to this Convention that: (a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;
(b) has been disposed of; or
(c) has resulted from past practices.
This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;
(v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

D.1.1 Management of spent nuclear fuel

Most spent nuclear fuel in Sweden emanates from commercial nuclear power plants at the Barsebäck (which was finally shut down 31 May 2005), Forsmark, Oskarshamn and Ringhals sites. Small amounts of spent nuclear fuel originate from the research reactors in Studsvik (which were finally shut down 15 June 2005). In addition, some spent nuclear fuel from the decommissioned research reactor R1 and from the closed Ågesta reactor must be managed.

Spent nuclear fuel from the NPPs is temporarily stored in fuel pools, before being transported to the central interim storage for spent nuclear fuel (Clab), where it will be stored for at least another 30 years before being encapsulated and deposited in a disposal facility.

Spent nuclear fuel elements from the closed research reactors R2 and R2-0 in Studsvik have been exported to the United States.

All spent fuel from the Ågesta district heating power reactor has been transferred to Clab. Spent fuel from the R1 research reactor consists of rods of metallic uranium enclosed in an aluminum alloy casing. This type of fuel is not suitable for disposal in accordance with the KBS-3 method. It has since the closure of the R1 reactor been temporarily stored at the Studsvik site. During 2007 the intact parts of the fuel was separated from corroded parts, in the form of powder and lumps, and transported to the United Kingdom. The intact parts were reprocessed in 2008. The fissile material from the reprocessing of the R1-fuel are planned to be manufactu-

red to MOX-fuel and the other remaining waste from the reprocessing have been sent back to Sweden in 2009. The waste is temporarily stored at the Studsvik site before transport to disposal facility.

The corroded parts of the R1-fuel are still temporarily stored at the Studsvik site before transport to disposal facility. Since it was discovered that the corroded parts might contain metal, the material has been trickled and split up into different fractions, resulting in 23 steel cans. The cans with the smallest fraction (less that 1 mm) were later repacked into three steel canisters.
No spent nuclear fuel is currently disposed of in Sweden.

D.1.2 Spent nuclear fuel facilities and inventories

D.1.2.1 Interim storage at the nuclear power plants

Each NPP unit has a fuel pool, close to the reactor vessel, in which spent fuel is stored temporarily for at least nine months before being transported to Clab. The fuel pools constitute integrated parts of the reactor facilities, and are for the purpose of the Joint Convention not considered to be separate spent fuel management facilities. The amount of spent fuel stored in pools at the nuclear power stations as of 2010-12-31 is presented below. The pool capacity listed corresponds to the storage capacity dedicated for spent fuel. The pools also have space for the plundered reactor core, fresh fuel, scrap and boxes.

Fuel pool at NPP	Pool capacity (no of fuel assembly positions)	Spent nuclear fuel stored 2010-12-31 (no of assemblies)	(tonnes*)
Oskarshamn 1	908	366	55
Oskarshamn 2	1022	271	44
Oskarshamn 3	1040	328	58
Forsmark 1	614	402	67
Forsmark 2	493	367	61
Forsmark 3	340	262	44
Ringhals 1	1426	283	49
Ringhals 2	432	114	52
Ringhals 3	381	195	90
Ringhals 4	364	165	76

*uranium weight

Table D1: Inventory of spent fuel in NPP pools.

D.1.2.2 Spent nuclear fuel facilities and inventories at Studsvik

As described above, remaining waste from the reprocessing of the intact parts of the R1-fuel is temporarily stored on site at Studsvik before transport to disposal facility. The corroded parts of the R1 fuel are temporarily stored on site before transport to disposal facility.

Spent nuclear fuel in storage 2010-12-31		
origin	**no of assemblies**	**kg***
R1**	12+3***	82,3****

*uranium weight
**The corroded parts of the R1 fuel
***12 steel cans and 3 steel canisters
****Consists mostly of uranium dioxide (uo2)

Table D2: Spent fuel from the research reactor R1 temporarily stored in Studsvik.

D.1.2.3 The central interim storage for spent nuclear fuel, Clab

Spent fuel assemblies will, as mentioned above, be stored at the Clab facility for at least 30 years. The main reason is to let the heat generation decay by about 90 %, before encapsulation and disposal. Other highly radioactive components such as control rods from reactors are also stored in Clab awaiting disposal.

After being removed from the cask in an unloading pool, the spent fuel assemblies are transferred to storage canisters for subsequent transport and storage. A water-filled elevator cage takes the storage canister down to the storage section where it is placed in a predetermined position in a storage pool. Thus, unloading and all subsequent handling of spent fuel assemblies are performed under water using hydraulic machines.

Approximately 100 people work at the facility, a third of them with the day-to-day operation and the others with radiation protection, chemical sampling, maintenance and repairs. At the turn of the year 2006/2007 the license holder for Clab, SKB, took over the operation of the Clab facility, which earlier was handled by OKG.

The water, which circulates in a closed system, acts both as coolant and as an effective radiation shield, and no additional radiation protection equipment is needed. The water is circulated through filters to keep it clean before being returned to the pools. The heat is removed in heat exchangers, cooled by seawater, in an intermediate cooling system. There are back-ups for all safety systems, and an emergency diesel-powered generator. Vital parts of the monitoring and control systems can be powered by a battery back-up system. The storage pools are designed to withstand seismic loads, and also for extreme temperature loads in case the cooling systems should fail.

The central interim storage for spent nuclear fuel, Clab is shown in figure A8. Principal data and inventories are listed below.

Principial data for Clab	
Owner and license holder:	Swedish Nuclear Fuel and Waste Management Co (SKB)
Operation and maintenance:	SKB
Start of construction:	1980
Start of operation:	1985
Number of staff:	Approximately 100
Storage capacity:	8 000 tonnes of uranium
Receiving capacity:	300 tonnes uranium per year
Number of storage pools:	8 + 2 in reserve
Pool temperature (normal conditions):	Maximum 36°C
Cooling capacity:	8.5 MW

Table D3: Principal data for Clab

Specification	Spent nuclear fuel stored 2010-12-31 (no of assemblies)	(tonnes)
BWR fuel	23 230	3 937
PWR fuel	2 877	1 240
Fuel from Ågesta district heating nuclear power reactor	222	20,2
Fuel from Studsvik	19	2,5
German MOX-fuel (exchanged for Swedish fuel reprocessed in France)	217	22,5
Total	26 565	5 222
Storage capacity		8 000

Table D4: Inventory of spent fuel stored in Clab 2010-12-31.

D.1.3 management of radioactive waste nuclear power plants

Waste management at the NPP sites is fully integrated into the operations at each site. Fulfillment of the requirements in SSM's general regulation is accomplished and verified through regulatory review and inspection activities at the nuclear power plants, as reported in the Swedish reports under the Convention on Nuclear Safety. Temporary storage of radioactive waste at the nuclear power plant sites is in practice an integrated part of the site.

Waste with very low activity (VLLW) is disposed of in shallow land burials on site, except for Barsebäck. VLLW from Barsebäck is disposed of in SFR.

Short-lived low and intermediate level waste (LILW) from the nuclear power plants consists of ion exchange resins from filters, metal scrap, pipes, valves, pumps, and tools and protective clothes. The waste is classified and handled initially on site, in preparation for disposal. The purpose of the waste handling at the power plants is to reduce the volume, to solidify wet waste in concrete or bitumen, and to pack the waste in suitable packages. Four types of standard packages are used, as well as standard ISO containers (see figure D1). Waste packages are stored temporarily in a buffer storage on site before being transported to the disposal facility for operational waste, SFR.

Figure D1: Standard packages for short-lived LILW used in Sweden.

The waste is treated differently at the different nuclear power plants. The table below describes methods and packages for operational waste produced at the nuclear power plants.

Type of waste	Ringhals	Barsebäck	Oskarshamn	Forsmark
Ion exchange resins	Solidified in concrete, packed in concrete moduls and steel moulds.	Solidified in concrete and packed in steel drums. Dewatered and packed in concrete tanks.	Solidified in concrete and packed in concrete drums. Dewatered and packed in concrete tanks.	Solidified in bitumen and packed in steel moulds. Dewatered and packed in concrete tanks.
Metal scrap and residues	Casted in concrete and packed in concrete moulds. Packed in standard ISO containers.	Packed in standard ISO containers.	Casted in concrete and packed in concrete moulds.	Packed in steel moulds. Packed in standard ISO containers.
Sludges	Solidified in concrete, packed in concrete moulds.			

Table D5: Waste treatment methods at the NPPs (no more operational waste is currently produced at the Barsebäck site after the closure of the plant).

D.1.4 Radioactive waste facilities and inventories

D.1.4.1 Radioactive waste treatment facilities and inventories

At the OKG site, the interim storage for low and intermediate level waste is built in a rock cavern. At the other nuclear power plants sites, there are special buildings for interim storage of conditioned operational waste located on the nuclear plant site. Safety reports exist for all facilities where radioactive waste is handled and stored. The safety reports describe the facility and the waste handling activities, the content of radioactive substances, supervising activities and include a safety analysis. As waste packages from the NPP sites are transported to SFR on a regular basis it is not relevant for the purpose of the Joint Convention to present a list of the inventories for the interim storage at the sites.

D.1.4.2 Radioactive waste management facilities at Studsvik

Hot cell laboratory, HCL
The Hot Cell Laboratory, built in the late 1950's, is primarily used to investigate irradiated nuclear fuel, although it is also used for studies of other types of irradiated materials. In addition, the laboratory is used for the conditioning, treatment and encapsulation of spent fuel fragments in packages suitable for interim storage in other facilities. The Laboratory has seven cells with thick concrete walls, and lead windows, to protect the personnel from ionising radiation. All waste is removed from the laboratory after conditioning.

The incineration facility, HA
The facility is used for incineration of solid low-level waste (LLW) from NPPs, hospitals, research institutions, and from facilities in Studsvik. The activities comprise management, radiological measurement and final conditioning of the waste. Ashes are stabilized in concrete for disposal or, if the waste comes from overseas, returned to the origin for further management. The current license permits the treatment of 600 tons of combustible waste annually.

The melting facility, SMA
The melting facility in Studsvik is used for volume reduction of contaminated metal. After melting and radiological measurement, the material may be exempted from regulatory control or returned to the source for further management. The current license permits the treatment of 5 000 tons of metal annually.

Treatment facility for intermediate waste, HM
The facility is used for the treatment of intermediate solid and liquid waste from other facilities in Studsvik. Treatment of solid waste comprises sorting, volume reduction (compaction), packing and conditioning by means of stabilization with concrete. Treatment of liquid waste comprises sedimentation and solidification by means of stabilization with concrete.

Interim storage for low and intermediate waste, AM
The AM facility was constructed in the 1980s for the interim storage of conditioned waste from other treatment facilities from the Studsvik site. The storage is constructed in a cavern in crystalline bedrock with a rock cover of at least 20 meters. The rock mass is grouted with concrete, the walls are reinforced by means of rendering concrete, and special arrangements have been made to drain the rock.

The storage facility is dimensioned to receive waste until about the year 2045. The storage area is divided into two parts; one part is used for waste that requires shielding and the other is used for waste for which shielding is not necessary. The shielded part of the AM storage has a capacity of about 4 000 m^3, corresponding to 1632 moulds and 1020 four-drum unit trays, the unshielded part has a capacity of about 1120 m^3, corresponding to 660 moulds and 264 four-drum unit trays. A further 1 000 drums can be deposited in others parts of the storage. The waste is conditioned and packed in special containers before being positioned in the storage. The ventilation and drainage systems are monitored for any radioactive substances.
The following types of waste originating from the Studsvik facilities are currently being stored at AM:

- operational waste from the research reactor R2 and the tests that were performed in the reactor,
- irradiated and contaminated material from the production of isotopes,
- irradiated and contaminated material from the fuel testing laboratory, and
- start sources from an old research reactor and- operational waste from the waste handling facilities.

Externally produced types of waste currently being stored at AM are:

- rest products from incinerated waste from nuclear power plants, hospitals and industry,
- rest products from the use of isotopes in industry and hospitals,
- decommissioning waste from old nuclear facilities and
- waste from treatment of steam generators from Ringhals

Number of packages	Volume (m^3)*	Mass (tonnes)*	Activity (Bq)
3 854	2 168	3 795	8,63*1015

*including packaging

Table D6: Inventory of disposed radioactive waste in AM 2010-12-31.

Storage facility for solid intermediate waste, AT
The facility, which was built for the purpose of the temporary storage of intermediate and high level solid waste from the reactor R2, is 44 meters long, 9 meters wide and comprises a concrete slab with circular and rectangular storage positions. The walls and roof are constructed of sheet metal on a steel structure. The facility is heated by means of air conditioning and the outgoing air is filtered. The facility is nowadays used for temporary storage and for various project activities.

The storage facility, FA
This facility, which contains three water pools, was built in 1965 for the interim storage of spent nuclear fuel from the Ågesta reactor. As all fuel from Ågesta has been transferred to Clab the facility may be used for other purposes such as storage of spent fuel from other reactors, or for storage of other radioactive materials.

The facility comprises a main building and an extension. The main activities are carried out in the main building. There are three pools which can be used for

loading/unloading of transport casks, two of the pools are equipped with storage racks for the storage of spent fuel assemblies and other radioactive material.

The storage pools are built in reinforced concrete and lined with stainless steel. They have a depth of 8.2 m, and a diameter of 3.8 m. The basement contains service areas and equipment for management of the piping and water systems. The ventilation and drainage systems are monitored for any radioactive substances. The extension comprises a three-storey building. The basement contains rooms for secondary service systems; the ground level contains the entrance section and dressing rooms; and the attic contains air condition and ventilation installations systems.

Storage facility for radioactive waste, AU
The AU facility is an interim storage for conditioned long-lived, low level, waste and is a simple, non-heated, building made of concrete and steel. The AU storage facility contains drums with historical waste consisting of scrap metal embedded in concrete. During the 1990's the waste was reconditioned. X-ray examination of all the waste and scrap metal drums are currently being performed. This includes the about 5 500 drums that previously were stored in the facility, together with the drums that has been stored outside the facility (in containers, AT and AM). The examination started in 2009 and will be finished in 2011. Installation of a mobile pallet system started in 2011. The system shall be able to hold all the waste and scrap metal drums (about 7200).

The waste will be disposed of in the disposal facility for other long-lived waste. No more new waste will be stored in the AU building.

Treatment facilities for radioactive non-nuclear waste, FR0-A and R0-A
Disused sealed sources and radioactive waste from medical use, research and industry are mainly managed in the two facilities FR0-A and R0-A. In R0-A ionizing smoke alarms are dismantled in R0-A, whereas all other disused sealed sources and radioactive waste are treated in FR0-A. Depending on activities, dose rate, material, etc, treatment comprise sorting, volume reduction, packing and conditioning. Some of the disused sealed sources and radioactive waste may also be treated in the facilities HA, SMA or HM.

Monitoring at Studsvik facilities
Whenever there is risk for airborne emissions, ventilation and/or exhaust systems are monitored for any radioactive substances. Likewise, to avoid contamination from waste water, common drainage systems are monitored for any radioactive substances before the water is released to the recipient.

D.1.4.3 Disposal facility for short-lived low- and intermediate level waste (SFR)

General information
The capacity of SFR is approximately 63 000 m^3, and 33 871 m^3 of waste had been disposed of by 2010-12-31. In the safety assessment the total radioactivity of this waste is assumed to be 1E16 Bq.

The disposal facility is designed to isolate the waste from the biosphere in

order to avoid harmful consequences to man and the environment both during operation and after closure. This is accomplished by emplacement in rock under the seabed, and by the technical barriers surrounding the waste. SFR consists of the Silo, the rock vault for intermediate level waste (BMA), two rock vaults for concrete tanks (1BTF, 2BTF) and the rock vault for low level waste (BLA). The storage vaults are located in the bedrock, approximately 60 m below the seabed, 1 km from the shore. The underground part of the disposal facility is accessed through two tunnels.

The Silo
The main part of the radioactivity in the waste designated for SFR is intended for disposal in the Silo. This waste comes from many different waste streams, but the most important one comprises ion exchange resins from the nuclear power plants in a concrete or bitumen matrix. Other waste like metal components of different origins is also disposed of in the Silo. The amount of organic material is kept to a minimum. The maximum surface dose rate permitted on a package is 500 mSv/h. All handling of waste packages is performed using remote control equipment. The dominant nuclides are Co-60 and Cs-137.

The Silo consists of a cylindrical concrete construction with shafts of different sizes for waste packages. The concrete cylinder is approximately 50 m high, with a diameter of approximately 30 m, and the largest shafts measure 2.5 m by 2.5 m. The waste packages are placed in the shafts, normally in layers of four moulds or 16 drums. The spaces between the waste packages are gradually back-filled with porous concrete. The walls of the Silo are made of 0.8 m thick reinforced concrete. In between the walls and the surrounding rock there is a bentonite backfill, on average 1.2 m thick. The 1 m thick concrete floor at the bottom of the Silo is placed on a layer of 90/10 sand/bentonite mixture.

According to present plans a 1 m thick concrete lid will cover the top of the Silo. The lid will after closure be covered with a thin layer of sand, a 1.5 m thick layer of sand/bentonite mixture (90/10) and the remaining space will be filled with sand, gravel or sand stabilized with cement.

The rock vault for intermediate level waste (BMA)
The radioactivity in the waste that is disposed of in BMA is generally lower than in the waste in the Silo. The waste in BMA comes from many different waste streams. The most important one is ion-exchange resins from the nuclear power plants. Other waste such as metal components of various origins as well as contaminated rubbish is also disposed of in BMA.

The maximum dose rate permitted on packages is 100 mSv/h, and the radionuclide content is fairly low. BMA has been designed to handle approximately 6% of the radionuclides in SFR. The dominant nuclides are Co-60 and Cs-137. The waste packages are of the same type as in the Silo, i.e. moulds and drums.

The rock vault is approximately 160 m long, 19.5 m wide with a height of 16.5 m. Inside the cavern a concrete construction has been raised such that the vault is divided into 15 compartments. The waste, moulds and drums, are placed in the compartments using remote controlled equipment.
The waste is piled on top of the concrete floor in such a way that the concrete moulds act as support for prefabricated concrete slabs, put in position as soon as the compartments are filled. It is also possible to back-fill the void between the

waste packages in a compartment. Finally a layer of concrete will be cast on top of the lid. Between the concrete structure and the rock wall there is a 2 m wide space, which will be filled with sand before closure. The space above the concrete structure may be left unfilled, but could also be backfilled. Plugs will be placed in the two entrances to the vault when the disposal facility is closed.

The rock vaults for concrete tanks (BTF)
In SFR there are two rock vaults for concrete tanks, 1BTF and 2BTF. The waste in 1BTF mainly consists of drums containing ash and concrete tanks containing ion-exchange resins and filter parts, whereas the waste in 2BTF consists of only the latter. Moreover, some large components of metal e.g. steam separators or reactor vessel lids may be disposed of in the caverns.
The maximum dose rate permitted on packages is 10 mSv/h. The radionuclide content is fairly low, and the dominant nuclides are Co-60 and Cs-137. The rock vaults are approximately 160 m long, 14.8 m wide with a height of 9.5 m. The concrete tanks, each 10 m^3 in volume, are piled in two levels with four tanks in each row. A concrete radiation protection lid is placed on top of the pile. The space between the different tanks is backfilled with concrete, and the space between the tanks and the rock wall will be filled with, for example, sand stabilized with cement.

The rock vault for low level waste (BLA)
The waste that is disposed of in BLA - short-lived waste - is mainly low level scrap metal (iron/steel, aluminum); cellulose (e.g. wood, textile, paper), other organic materials (e.g. plastics, cables) and other waste such as insulation (e.g. rock wool) packed in standard steel containers.
The maximum dose rate permitted on the surface of the waste packages is 2 mSv/h. The radionuclide levels are low, and the dominant nuclide is Co-60. Some of the waste inside the containers is placed in steel drums and others in bales.

The rock vault cavern is approximately 160 m long, 15 m wide with a height of 12.5 m. The cavern is very simple in design, basically there is only a concrete floor on which containers are placed. During the operational phase a ceiling has been placed above the waste in order to minimize water dripping onto the waste. This inner roof will be dismantled before the disposal facility is closed.
The containers are piled three high in rows of two. Most of the containers are half height allowing six to a pile. No backfilling is planned.
The SFR facility is shown in figure A9. Principal data and inventories are listed below.

Principal data for SFR	
Owner and license holder:	Swedish Nuclear Fuel and Waste Management Co (SKB)
Operation and maintenance:	SKB
Start of construction:	1983
Start of operation:	1988
Number of staff:	Approximately 25
Storage capacity:	63 000 m^3
Silo	Short lived LILW, max dose rate 500 mSv/h
BMA	Short lived LILW, max dose rate 100 mSv/h
1 BTF	Short lived LILW, max dose rate 10 mSv/h
2 BTF	Short lived LILW, max dose rate 10 mSv/h
BLA	Short lived LILW, max dose rate 2 mSv/h
Disposal capacity	6 000 m^3/year
Current disposal rate	1 000 – 1 500 m3/year

Table D7: Principal data for SFR

Waste disposed of in SFR 2010-12-31 **Storage section**	**Volume (m^3)**	**Activity (Bq) ***
Silo 5 265	5,1E14	
BMA9 087	2,6E14	
1 BTF	2 309	2,1E12
2 BTF including steam separators**	7 010	1,5E13
BLA 10	5,5E11	
SFR total	33 871	7,9E14

* Activity values per 2009-12-31
** 18 packages

Table D8: Inventories of disposed radioactive waste in SFR 2010-12-31.

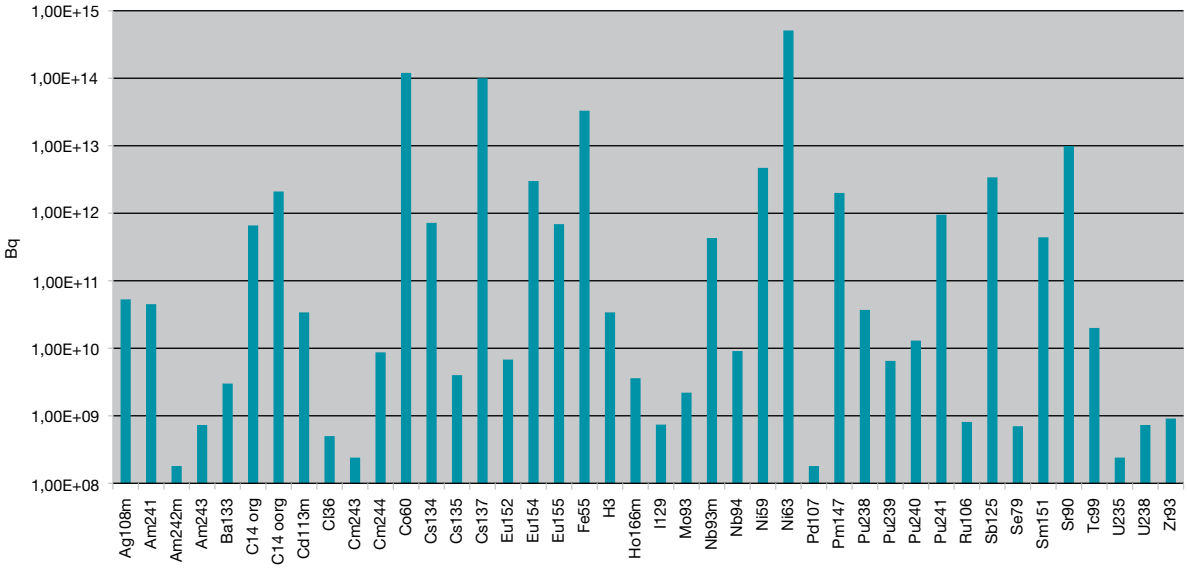


Figure D2: Activity content in SFR. The numbers are for the situation in 2009-12-31.

D.1.4.4 Shallow land burial

The nuclear power plants at Ringhals, Forsmark and Oskarshamn as well as the Studsvik site have shallow land burial facilities for very low-level waste. When licensing the shallow land burial facilities, the main criterion is that the releases of radionuclides from the facilities shall not contribute significantly to the releases from the already existing nuclear facilities at the site. Therefore, the total activity content is limited to 100–1100 GBq per facility. The highest level according to the legislation is 10 TBq, of which a maximum of 10 GBq may consist of alpha-active substances. Waste is disposed of in campaigns at 3–5 year intervals, and the facilities are closed in between the campaigns.

The design and layout of the shallow land burial facilities differs but all facilities have a top sealing layer to reduce the infiltration of water. The design of the top sealing layer differs between the different facilities; both bentonite liners, plastic membranes and massive layers of glacial clay have been used, as well as mixed designs. The closed burial facilities are finally covered with a protective layer of e.g. soil, approximately 1 metre thick. At the newer installations in Ringhals and Oskarshamn a geological barrier has been installed down-gradient of the disposal facility. At the repositories in Forsmark and Studsvik a natural or semi-natural geological barrier reduces leakages to the environment. There are monitoring programmes for sampling leachate water, e.g. with respect to radionuclides.

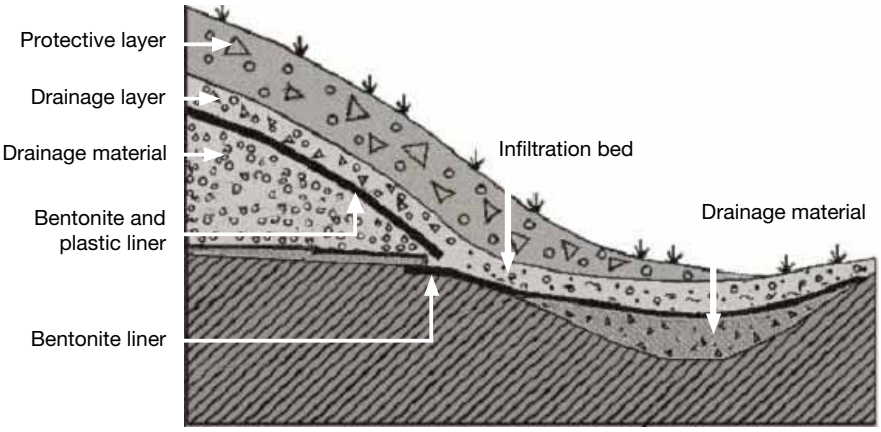


Figure D3: Principle section of shallow land burial at OKG.

The waste disposed of at the three nuclear power plants consists of low-level ion exchange resins, piping, tools, isolation material, protective clothes and rubbish such as plastics, paper and cables. The predominant nuclides are Co-60, Cs-137 and Ni-63.

At the shallow land burial in Studsvik also waste from the decommissioning of various old nuclear installations and operational waste from the Studsvik facilities has been disposed of, dominated by the following nuclides: Co-60, Cs-137, H-3, Eu-152 and Eu-154.

Figure D4: The shallow land burial at OKG.

In the older licenses the total activity concentration was limited to 300 kBq/kg for radionuclides with a half-life longer than 5 years. When the license conditions for the shallow land burial facilities in Forsmark, Ringhals and Oskarshamn were renewed, nuclide specific acceptance criteria was established.

The Regulations on the Protection of Human Health and the Environment in connection with Final Management of Spent Nuclear Fuel and Nuclear Waste (SSMFS 2008:37) does not include shallow land burial facilities for low-level nuclear waste. There are, however, plans to issue regulations specifically for shallow land burial facilities. The regulations will be applicable to siting, design and operation issues that can influence both the short- and long-term performance of the facility.

	License conditions			Waste disposed of 2010-12-31		
Site	Licence period	Volume (m^3)	Max activity/max alpha activity (GBq)	Mass (ton)	Volume (m^3)	Activity/alpha (GBq)
Forsmark	2 040	17 000	200/0.2	3 415	5 231	35/0.0004
Oskarshamn	2 075	10 000	200/0.2	3 768	7 346	38/0.0028 *
Ringhals	2 030	10 000	1100/0.1	3 640	5 942	181/0.046 ***
Studsvik (SVAFO)	2 010	1 540 **	100/0.1	1 151	1 140	39/0.055 *

* Valid 2004-12-31
** The license for further disposition has not been renewed by SSM. The license volume can therefore not be used to its full extension.
*** Valid 2008-08-19

Table D9: Inventories of disposed waste in shallow land burials.

In addition to the above mentioned limits the following applies to the shallow land burials. For Ringhals a maximum of 2 GBq Sr-90, 900 GBq Ni-63 and 100 GBq of other beta emitters with a half life longer than 5 years (e.g. C-14, Ni-59 and Cl-36) is allowed.

D.1.4.5 Waste from fuel fabrication

Westinghouse Electric Sweden AB operates a factory for the fabrication of nuclear fuel in Västerås (approximately 100 km west of Stockholm), which has been manufacturing fuel since the mid-1960s. The annual production is approximately 400 tonnes of UO_2 fuel for PWR and BWR, mostly for foreign customers.

The manufacturing process generates some slightly uranium contaminated waste in the form of sludge, filters, protective clothing, etc. Westinghouse disposes of small amounts of waste with very low uranium content, typically filters, at municipal landfills as permitted by the regulatory authority. Most of the uranium in the waste is however first extracted through special recovery processes in the Västerås plant. Also, new processes are currently being developed together with partners such as Studsvik, to further decrease the amount of uranium in the waste. A minor part of the remaining waste can be considered for a future storage in a disposal facility.

D.1.5 Nuclear facilities under decommissioning

D.1.5.1 Experiences from past decommissioning activities

Sweden has limited experience from decommissioning of nuclear facilities. It is limited to the decommissioning of the R1 research reactor and laboratories in Stockholm as well as some smaller test facilities and laboratories in Studsvik. The most relevant decommissioned facilities are listed below.

The research reactor R1, which was in operation between 1954 and 1970, was situated in a rock cavern in central Stockholm and was used for research and isotope production. The reactor was decommissioned between 1981 and 1983, and the site was released for unrestricted use in 1985. Virtually all waste was shipped to Studsvik. Exceptions were electric motors, handrails, stairways, etc, from non-classified areas that were released for unrestricted use. All waste and salvageable material produced at R1 was measured and registered. The measurements were nuclide-specific and were done using a gamma-ray spectrometer. The graphite from the reflector was packed in steel boxes and is temporary stored in the storage facility AM at Studsvik.

The research reactor R0, a ”zero power” reactor in Studsvik, was a low power reactor, which was in operation between 1959 and 1968. The normal operational power was about 1 W, and the maximum power was 50 W. The reactor vessel was transferred to R2 (another reactor in Studsvik) for alternate usage. Some parts could not be decontaminated and were packed and stored in Studsvik. The concrete elements from the radiation shield were disposed of in a refuse disposal facility in Studsvik, since no activity could be measured.

The KRITZ-reactor was an experimental reactor in Studsvik with a maximum power of 100 W, used between 1969 and 1975. The reactor vessel was equipped with a radiation protection shield of lead. The lead protection could, after measurements, be released from regulatory control and was sold. The reactor vessel could also be released, except for an inner tank with induced activity, which was packed and stored at the Studsvik site.

The Alfa-laboratory in Studsvik was mainly used for studies on steel used in pressure vessels and on irradiated fuel cladding material. The work in the laboratory started in the beginning of the 1960’s and the laboratory was in operation for about 25 years. The laboratory contained seven ventilated hot cells built of lead bricks. After decontamination some of the lead bricks and other components could be released from regulatory control, others were packed in special packages for interim storage. The building was released for unrestricted use in 1985.

The Van de Graaff laboratory in Studsvik was used for neutron physics experiments between 1962 and 1989. The building was not classified as a nuclear facility but later it was found to be contaminated with tritium. An extensive measuring program was performed to identify the contaminated material and surfaces. After decontamination the building was released from regulatory control and demolished in 1999. Three drums and one steel box with tritium contaminated waste are now stored in the interim storage AM in Studsvik. Non-radioactive waste, classified as hazardous, was separated and transported to SAKAB, a company managing non-radioactive hazardous waste.

The central active laboratory (ACL) in Studsvik was built between 1959 and 1963 with the purpose to be used as a research facility for reprocessing spent fuel. The activities in the laboratory ended in 1997, and involved for example research

on plutonium enriched fuel, plutonium analyses, material testing and test fabrication of rods with MOX-fuel. Cleaning and decontamination work was started after an extensive measurement program. The building was released for unrestricted use in the beginning of 2006. The demolition work was carried out during 2006.

A general observation concerning the above activities is that - despite the lack of regulations regarding decommissioning - the activities were performed without any accidents, due to the knowledge about regulations on transport and handling, and experience from radiological work of the people involved.

D.1.5.2 Nuclear facilities currently under decommissioning

The nuclear power units Barsebäck 1 and Barsebäck 2, which were closed in November 1999 and in May 2005, respectively, were the first commercial nuclear power units to be permanently taken out of operation in Sweden. The Government decided that the reactors should be shut down as part of the policy to phase out nuclear power in Sweden. All spent fuel has been transferred to the central interim storage for spent fuel (Clab). Already before the units were shut down the regulatory authorities increased their control and review activities at the site to ensure that there would be no decline in the safety work. An overall decommissioning plan for the units has been submitted to, and approved of, by the regulatory authorities. A revised version is under way and is planned to be submitted during 2012. The decommissioning work has commenced to a certain degree. After the spent fuel was transported to Clab the units went into service operation on 1 December 2006, i.e. only the most necessary systems are running, such as ventilation, monitoring of activity etc. Some equipment has also been disposed of. According to current plans, large scale dismantling and demolishing work will begin not sooner than 2020.

The Ågesta district heating nuclear power reactor (heavy water) was operated between 1964 and 1974 supplying parts of the Stockholm suburb Farsta with heated water. The reactor is now shut down in such a manner that it is not possible to start it up again. The fuel from the reactor has been transferred to Clab for interim storage. The heavy water has been removed and two, out of four, steam generators have been dismantled, but otherwise the facility is more or less intact. Detailed planning for its decommissioning is underway and is being closely monitored by the regulatory bodies.

The tank and silo facility (TS) in Studsvik was constructed at an early stage, with the purpose of storing liquid and semi-liquid radioactive waste. The silo part of TS is subject for decontamination, release of material for unrestricted use and, later, dismantling. The tank part of TS will remain and is used for interim storage of intermediate-level liquid waste (category 3).

The research reactors R2 and R2-0 in Studsvik were finally shut down 15 June 2005. The regulatory body have closely followed the developments at the site. Part of the spent nuclear fuel from the reactors was returned to the United States in 2007. The remaining part of the fuel was returned to the United States in 2008. The reactor building and reactor pool has since June 2005 been emptied on some of the loose equipment. Dismantling of fixed equipment has not yet begun. By a government decision, AB SVAFO obtained the nuclear license for R2 and R2-0 which earlier belonged to Studsvik Nuclear AB. The license was granted on 16 December 2010 and the transfer of the reactor facility is now completed. AB SVAFO will now be responsible for the further decommissioning work.

This page is intentionally left blank

E.1 Article 18: IMPLEMENTING MEASURES

> Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

The legislative, regulatory and other measures to fulfill the obligations of the Joint Convention are discussed in this report.

E.2 Article 19: LEGISLATIVE AND REGULATORY FRAMEWORK

> 1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.
> 2. This legislative and regulatory framework shall provide for:
>   (i) the establishment of applicable national safety requirements and regulations for radiation safety;
>   (ii) a system of licensing of spent fuel and radioactive waste management activities; (iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence;
>   (iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;
>   (v) the enforcement of applicable regulations and of the terms of the licences;
>   (vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.
> 3. When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

Summary of developments since the last national report

- SSM has reissued former SKI and SSI regulations in its Code of Statutes, SSMFS.
- On January 1 2011 the previous ban on constructing new reactors was removed through amendments to the Act (1984:3) on Nuclear Activities and the Environmental Code. The ten (10) current reactors in Sweden may be replaced with new, provided that they are erected on the same site as the existing.
- The SSM has updated the regulatory requirements on the content and use of Safety Analysis Reports (SAR) in the Regulations concerning Safety in Nuclear Facilities (SSMFS 2008:1).

- A Committee of Inquiry on merging the provisions of the Act on Nuclear Activities and the radiation Protection Act (1988:220) has submitted its final report to the Government (SOU 2011:18). Harmonization with the provisions of the Environmental code is suggested. The report is presently subject to referral consultation with the SSM and other relevant stakeholders. Potential changes of the legal framework, in response to the Committee's proposals, can at the earliest be decided 2013/2014.
- By a new Ordinance on Supervision under the Environmental Code SSM became on Mars 31 2011 the supervisory authority for matters relating to radiation safety under the Code.

This section is divided into three parts. The first part (E.2.1) presents basic prerequisites for the legal and regulatory framework. The second apart (E.2.2) contains basic information concerning definitions within the Swedish legislative system, and presents an overview of the relevant acts. The third part (E.2.3) describes the implementation of the requirements in the regulatory review activities. Special emphasis is placed on the licensing system, prohibition, institutional control, regulatory inspection, documentation and reporting, enforcement of regulations and terms of a licence, and a description on the allocation of responsibilities of the bodies involved.

E.2.1 Basic prerequisites for the legal & regulatory framework

E.2.1.1 Fundamental principles for the management of spent fuel and radioactive waste

The rationales for the management system for spent fuel and radioactive waste are established on basic principles that have been derived from extensive discussions in the Swedish parliament during the 80's and 90's. The Swedish parliament has supported four basic principles for the management of spent nuclear fuel and nuclear waste (bill 1980/81:90, Appendix 1, p. 319, bill 1983/84:60, p. 38, bill 1997/98:145, p. 381, bill 1992/93:98, p. 29 as well as the final reports of the Standing Committee on Industry and Trade, 1988/89:NU31 and 1989/90:NU24):

1. The expenses for the disposal of spent nuclear fuel and nuclear waste are to be covered by revenues from the production of energy that has resulted in these expenses.
2. The reactor owners are to safely dispose of spent nuclear fuel and nuclear waste.
3. The state has the ultimate responsibility for spent nuclear fuel and nuclear waste. The long-term responsibility for the handling and disposal of spent nuclear fuel and nuclear waste should rest with the state. After a disposal facility has been closed, a requirement should be established to ensure that some kind of responsibility for and supervision of the disposal facility can be made and maintained for a considerable time. A government authority could assume responsibility for a closed disposal facility.
4. Each country is to be responsible for the spent nuclear fuel and nuclear waste

generated in that country. The disposal of spent nuclear fuel and nuclear waste from nuclear activities in another country may not occur in Sweden other than in an exceptional case.

These are the basic principles for the structure of the Act (1984:3) on Nuclear Activities. They are also contained in the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities.

The first principle has been wholly incorporated into the Financing Act. The second principle has been regulated in 10-12 §§ of the Act on Nuclear Activities. Regarding the third principle, the Government has in a statement accepted by the Parliament, noted that it is in the very nature that the State has ultimate responsibility for operations, as it is regulated in the Act on Nuclear Activities, also in the very long term. The fourth principle is expressed in 5 a §, second paragraph, of the Act on Nuclear Activities.

Another basic prerequisite for the actual management of spent fuel is that reprocessing will not take place. Thus, spent nuclear fuel is in practice considered as, and treated as, waste, although it is not legally defined as waste until disposed of in a disposal facility.

E.2.1.2 Nuclear and radioactive waste

In the Act (1984:3) on Nuclear Activities, radioactive waste produced by nuclear activities is defined as ”nuclear waste”. The precise definition according to the act is presented in the next section.
In the Radiation Protection Act (1988:220) the term ”radioactive waste” is used. The term includes radioactive waste from nuclear activities as well as from non-nuclear activities (medical use, use of sealed sources, research institutions, consumer products, etc.).

E.2.2 Legislative framework

The framework of Sweden’s legislation in the field of waste management, nuclear safety and radiation protection, is to be found in five Acts with associated Ordinances:

- the Act (1984:3) on Nuclear Activities;
- the Radiation Protection Act (1988:220);
- the Environmental Code (1998:808);
- the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities; and
- parts of the Act (2000:1064) on the Control of Dual- use Items and Technical Assistance.

E.2.2.1 The Act on Nuclear activities

The Act (1984:3) on Nuclear Activities is the basic law regulating nuclear safety. It contains basic provisions concerning safety in connection with nuclear activities, and applies to the handling of nuclear material and nuclear waste as well as to the operation of nuclear plants.

The Swedish Parliament has on several occasions declared that Sweden supports and will follow the principle of each country’s responsibility to take care of and dispose of spent fuel and radioactive waste produced within the country.

Disposal, as well as interim storage, of foreign spent fuel and nuclear waste in Sweden is prohibited.

A special licence may however be granted by the Government in special cases, to allow for very small amounts of foreign spent fuel or radioactive waste to be disposed of in Sweden, provided that it does not hinder the R&D-programme regarding safe disposal of spent fuel in Sweden.

The Act does not contain provisions concerning radiation protection. This is regulated in a separate act, the Radiation Protection Act (see section E.2.2.2). As far as nuclear activities are concerned, the Radiation Protection Act and the Act on Nuclear Activities should be applied in parallel and in close association with each other.

Definitions

The handling, transport or other dealings with nuclear waste are defined as nuclear activity. The precise definition of nuclear waste is:

- spent nuclear fuel that has been placed in a disposal facility
- radioactive material that has been generated in a nuclear facility and that has not been produced or taken from the facility to be used for educational or research purposes or for medical, agricultural engineering or commercial purposes
- material or other item that has belonged to a nuclear facility and become contaminated by radioactivity and which shall no longer be used in such facility, and
- radioactive parts of a nuclear facility that is being decommissioned.

Basic requirements on safety

Nuclear activities shall be conducted so as to meet safety requirements and fulfil the obligations pursuant to Sweden's agreements for the purpose of preventing the proliferation of nuclear weapons and unauthorised dealing with nuclear material and spent nuclear fuel.

Safety in nuclear activities shall be maintained by taking all measures required to prevent errors in or defective functioning of equipment, to prevent incorrect handling or any other circumstances that may result in a radiological accident, and to prevent unlawful dealings with nuclear material or nuclear waste. The Government or the authority appointed by the Government may issue more detailed provisions concerning these matters. As mentioned above SSM is mandated to impose detailed regulations.

Licensing

In principle, all activities with nuclear material or nuclear waste constitute nuclear activity for which a licence is required. However, nuclear waste and nuclear material with a very low level of radiation can be released from regulatory control.

General obligations of licensees and licence conditions

The licence-holder for nuclear activities shall be responsible for ensuring that all measures are taken needed for:

- maintaining safety, with reference to the nature of the activities and the conditions under which they are conducted;
- ensuring the safe handling and disposal of nuclear waste arising from the activities or nuclear material arising therein that is not reused; and
- the safe decommissioning and dismantling of plants in which nuclear activities are no longer to be conducted.

The holder of a licence for a nuclear activity has to ensure that all measures are taken, that are needed to maintain safety. These general requirements are supplemented by more detailed regulations issued by the SSM (see below) and if needed license conditions that the authority may issue in individual cases. The licensing conditions are imposed when a licence is issued. Licensing conditions can also be imposed during the period of validity of a licence.

Environmental impact assessment and general rules of consideration
Licensing of nuclear activities requires that an EIA (Environmental Impact Assessment) is submitted in connection with the application. Closer regulations on how the EIA should be carried out and what it should contain is given in the Environmental Code. In addition, the applicant must also show compliance with the general rules of consideration in the Environmental Code (see section E.2.2.4).

Safe management and disposal of nuclear waste
The holder of a licence for nuclear activities is responsible for the management and disposal of the waste produced and for decommissioning. The holder of a licence for the operation of a nuclear power reactor shall – in co-operation with the other holders of a licence for the operation of nuclear power reactors – establish and carry out a R&D-programme for the safe handling and disposal of spent fuel and nuclear waste. Every third year the programme shall be submitted to the SSM for evaluation. An important step in the evaluation process is that the program is sent for comments to a large number of stakeholders, such as other government organisations, municipalities, environmental organisations, research institutions and universities.

After the review SSM forwards the R&D-programme to the Government. The Government decides if the program can be approved or not. In connection with the decision, the Government may issue conditions about the content of the future R&D-programme.

Supervision
Compliance with the Act on Nuclear Activities and of conditions or regulations imposed pursuant to the Act is supervised by a regulatory body assigned by the Government. That body is SSM. A licence-holder shall if SSM requires it:

- submit all information and documentation necessary to perform the supervision; and
- provide access to a nuclear installation, or site for nuclear activities, investigations and taking of samples to the extent necessary to exercise

SSM may decide on any measures, conditions and prohibitions necessary in individual cases to implement the Act on Nuclear Activities, or regulations or conditions issued as a consequence of the Act.

Inspections
See section E.2.3.3

Documentation and reporting
See section E.2.3.3

Revocation and prohibition
A licence to conduct nuclear activities may be revoked by the authority issuing the permit if:

- conditions have not been complied with in some essential respect;
- the licensee has not fulfilled its obligations concerning research and development work on waste management and decommissioning, and there are very specific reasons from the viewpoint of safety to revoke the licence; or
- there are any other very specific reasons for revocation, from the viewpoint of safety.

This means that a revocation of a licence may be decided in cases of severe misconduct by the operator or otherwise for exceptional safety reasons. If the licence to operate a nuclear power plant is revoked, the licence holder remains responsible for waste management and decommissioning.

Sanctions
The Act on Nuclear Activities also contains provisions for safeguards, sanctions, etc. Anyone who conducts nuclear activities without a licence, or disregards conditions or regulations shall be sentenced to pay a fine, or to imprisonment for a maximum of two years. If the crime is intentional and aggravated, he shall be sentenced to imprisonment for a minimum of six months and a maximum of four years. Liability shall not be adjudged if responsibility for the offence may be assigned under the Penal Code or the Act on Penalties for Smuggling (2000:1225) or if the crime is trivial.

Regulations on civil liability for radiological damage are contained in the Atomic Liability Act (1968:45). The act is largely based on the contents of the Paris Convention on Nuclear Third Party Liability from 1960 and the Brussels Supplementary Convention from 1963, which Sweden has acceded.

Public insight
It is considered very important to give the public insight into and information on nuclear activities. In municipalities where major nuclear facilities are located (power reactors, research reactors, and facilities for manufacturing, handling, storage or disposal of nuclear material or nuclear waste) it is particularly important that the residents are given correct and reliable information. For this purpose so-called local safety boards have been established in the municipalities of Kävlinge (Barsebäck NPP), Oskarshamn (Oskarshamn NPP), Nyköping (Studsvik research facility), Varberg (Ringhals NPP) and Östhammar (Forsmark NPP).

The licence-holder for a major nuclear plant is required to give the local safety board insight into the safety and radiation protection work at the plant. The licence-holder shall, at the request of the board:

- give the board information of the facts available and allow the board to study relevant documents; and
- give the board access to plants and sites.

The function of the boards is to obtain insight into safety and radiation protection matters and to inform the public about these. It is therefore important to point out that the board is not supposed to impose requirements on or to prescribe safety-

enhancing or other measures for nuclear plants. These functions rest exclusively with the regulatory authorities.

The Ordinance (1984:14) on Nuclear Activities
The Ordinance contains detailed provisions on such matters as definitions, applications for licences, reviewing, evaluations and inspections.
The Ordinance also specifies that the regulatory authority assigned by the Government (SSM) is authorised to issue permits for transportation of nuclear materials and nuclear waste. The authority is in addition authorised to impose licence conditions and to issue general regulations concerning measures to maintain the safety of nuclear activities.

E.2.2.2 The Radiation Protection Act

The framework for all radiation protection is defined in the Radiation Protection Act (1988:220) and in the Radiation Protection Ordinance (1988:293). The present Act and the Ordinance entered into force in 1988. The purpose of the Act is to protect people, animals and the environment against the harmful effects of radiation. Persons engaged in activities involving radiation are obliged to take the requisite precautionary measures. They are also responsible for the proper handling and disposal of the radioactive waste produced, which includes covering the costs associated with both the handling and disposal of the waste.

Definitions
The Act applies to all activities involving radiation and these are defined to include all activities involving radioactive substances or technical devices capable of generating radiation.
Consequently the Act applies to radiation from nuclear activities and to harmful radiation, ionising as well as non-ionising, from any other source (medical, industrial, research, consumer products and NORM). As far as nuclear installations are concerned, the Act and the Act on Nuclear Activities are applied in close association with each other.
The Government or the responsible authority may, in so far it does not conflict with the purpose of the act, prescribe exemptions or certain provisions concerning radioactive substances or technical devises capable of generating radiation.

Basic requirements on radiation protection
The radiation protection in Sweden is based on the International Radiation Protection Commission's (ICRP) internationally recognised principles. These are:

- **Justification**

No activity is to be introduced until it has been shown to provide greater advantages than disadvantages to society. The basic principle of justification with regard to the management of nuclear and non-nuclear radioactive waste can not be questioned at this stage. The waste has been generated as a result of previous decisions.

- **Optimisation**

All radiation doses to individuals, the number of exposed individuals as well as

the probability of receiving doses must be kept as low as reasonably achievable, taking into account economic and social factors. This is often called the ALARA principle (As Low As Reasonably Achievable)

- **Dose limitation**

The individual exposure to radiation (dose) must not exceed the established limits for the particular circumstances. The dose limit or dose constraint can be seen as a limit for optimization; thus, the individual doses must not exceed the established limits, even if the collective dose would be reduced as a result.

The Government or the authority assigned by the Government may also issue further regulations as required for protection against, or control of, radiation in the respects specified in the Act.

Licensing

According to the Radiation Protection Act a licence is required for the following.

- The manufacture, import, transport, sale, transfer, leasing, acquisition, possession, use, depositing or recycling of radioactive substances.
- The manufacture, import, sale, transfer, leasing, acquisition, possession, use, installation or maintenance of a technical device capable of and intended for emitting ionising radiation, or a part of such a device that is of substantial importance from the viewpoint of radiation protection.
- The manufacture, import, sale, transfer, leasing, acquisition, possession, use, installation or maintenance of technical devices, other than those referred to in the previous sub-clause, and which are capable of generating ionising radiation and for which the Government or the authority appointed by the Government has prescribed a licence requirement.
- The export of radioactive substances if a licence is not granted according to the Act (2000:1064) on the Control of Dual-use Items and Technical Assistance.

A licence according to the Radiation Protection Act is not required for activities licensed according to the Act on Nuclear Activities.

General obligations of licensees and licence conditions

Any person who conducts activities involving radiation shall, according to the nature of the activities and the conditions under which they are conducted:

- take the measures and precautions necessary to prevent or counteract injury to people and animals and damage to the environment;
- supervise and maintain the radiation protection at the site, on the premises and in other areas where radiation occurs; and
- maintain the technical devices and the measuring and radiation protection equipment used in the activities correctly.

The provision implies that all measures should be taken to improve radiation protection; it is not sufficient only to follow regulations or conditions issued by the responsible authority.

The Government or the authority assigned by the Government may also issue any further regulations required for protection against, or control of, radiation in the respects specified in the act.

When a licence is, or has been, issued according to the Radiation Protection Act the responsible authority may impose conditions needed for radiological protection. Such conditions can also be imposed on activities licensed within the legal frame of the Act on Nuclear Activities.

Environmental impact assessment
The Government or an authority appointed by the Government may, in licensing cases, prescribe that the implementer prepares an EIA (Environmental Impact Assessment) before consent is given. Such an EIA shall be made in accordance with the rules in the Environmental Code (see section E.2.2.4).

Supervision
The Government assigns a regulatory body to supervise compliance with the Radiation Protection Act and licences and conditions issued in accordance with the Act. This body is the SSM. The SSM may decide on all measures necessary and all conditions and prohibitions required in individual cases to implement the Act, or regulations or conditions issued as a consequence of the Act.

At the request of the SSM, anyone who conducts activities involving radiation shall submit the information and provide the documents required for its supervision. SSM should also be given access to the installation or site where the activities are conducted, for investigations and sampling, to the extent required for its supervision.

Inspections
See section E.2.3.3

Documentation and reporting
See section E.2.3.3

Revocation and prohibition
A licence under the Radiation Protection Act may be revoked if regulations or conditions imposed pursuant to the Act have been violated in a significant respect or there are otherwise very strong reasons for revocation. Furthermore the Government, or the authority appointed by the Government, may issue prohibitions against e.g. the manufacture, sale, acquisition, possession or use of materials containing radioactive substances.

Sanctions
The Government and the responsible authority decide upon matters regarding licences under the Radiation Protection Act. A licence under this Act may be revoked if specific regulations or conditions have not been complied with in any significant respect, or if there are other very specific reasons.

Liability under the Act is not adjudged if responsibility for the offence may be assigned under the Penal Code or the Act on penalties for Smuggling (2000:1225). Nor is liability adjudged in the instance of a minor offence to be a trivial case. The police authority shall provide the necessary assistance for supervision.

Public information about radiation protection
One of the authority's missions is to inform the society about radiation protection issues. An education centre was established in 2004, which teaches courses in the area of radiation protection.

The Ordinance (1988:293) on Radiation Protection
The Ordinance contains detailed provisions pursuant to authorisation under the Radiation Protection Act. It stipulates that the regulatory authority assigned by the Government may issue regulations regarding further provisions concerning general obligations, radioactive waste and prohibitions against activities with certain materials, etc.

The Ordinance on Radiation Protection also stipulates that certain provisions in the Act do not apply to very low-level radioactive materials and technical equipment emitting only low-level radiation (exemption). The regulatory authority may also issue regulations concerning the release of very low- level radioactive material.

E.2.2.3 SSM Regulations on Nuclear Safety and Radiation Protection

With reference to its legal mandate, the Swedish Radiation Safety Authority (SSM), issues legally binding safety and radiation protection regulations for nuclear facilities in its Code of Statutes SSMFS. SSM has reissued all earlier regulations previously issued by SKI and SSI in the SSMFS series. In the following, regulations with relevance to the safety and radiation protection at nuclear installations, as defined by the Convention, are addressed.

In addition, general advice on the interpretation of most of the safety regulations is issued. The general advice is not legally binding per se. Measures should be taken according to the general advice or, alternatively, methods justified to be equal from the safety point of view should be implemented. The regulations and the general advice, listed below, all entered into force on February 1, 2009.

SSM's regulations also implement binding EU legislation and international obligations. In preparing SSM's regulations, IAEA safety standards, international recommendations, industrial standards and norms, and the rule-making of other Swedish authorities are considered. The SSM regulations are issued according to an established management procedure which stipulates technical and legal reviews of the draft. In accordance with governmental rules, a review of the final draft by authorities, licensees, various stakeholders, and industrial and environmental organizations is performed.

Regulations and General Advice Concerning Safety in Certain Nuclear Facilities (SSMFS 2008:1)
These general regulations is primarily written to apply to nuclear power reactors but is applicable in a graded way on all licensed nuclear facilities, no matter size or type of facility, i.e. research or materials testing reactors, fuel fabrication plants, facilities for handling and storage of spent nuclear fuel and facilities for handling, storage or disposal of nuclear waste.

The regulations aim at specifying measures needed for preventing and mitigating radiological accidents, preventing illegal handling of nuclear material and nuclear

waste and for conducting an efficient supervision. The regulations cover the following areas:

- Application of multiple barriers and defence-in-depth
- Handling of detected deficiencies in barriers and the defence-in-depth
- Organisation, management and control of safety significant activities
- Actions and resources for maintaining and development of safety
- Physical protection and emergency preparedness
- Basic design principles
- Assessment, review and reporting of safety
- Operations of the facility
- On-site management of nuclear materials and waste
- Reporting to SSM of deficiencies, incidents and accidents
- Documentation and archiving of safety documentation
- Final closure and decommissioning

General recommendations on the interpretation of the requirements are issued for most of the requirements.

Regulations concerning Safety in connection with the Disposal of Nuclear Material and Nuclear Waste (SSMFS 2008:21)
These regulations, in force since 2002, contain specific requirements on design, construction, safety analysis and safety report for disposal facilities, in view of the period after closure of the facility. For the period before closure, the general safety regulations (SSMFS 2008:1) apply.

The regulations, concerning the long-term safety for the disposal of spent nuclear fuel and nuclear waste, cover specifically:

- Qualitative requirements on the barrier system.
- Scenario definitions and classifications.
- Time scales for the safety assessment (as long as barrier functions are needed to isolate and/or to retard dispersion of radionuclides, but for at least 10 000 years).
- Topics to be covered in the safety report.

Regulations on exemption from the requirement on approval of contractors (SSMFS 2008:7)
The general rule is that a licensee cannot contract out an activity included in the nuclear licence without a permit by the Government or the SSM. For certain activities the permit procedure can be replaced by a notification to the regulatory body. SSM is to specify the prerequisites for such exemptions.

The regulations list activities that can be contracted out without a permit, e.g. building and construction work, decommissioning work, maintenance and inspection work, training, qualified expert tasks that cannot reasonably be done with own staff, and archiving of safety documentation. It is pointed out that the exempted activities shall only be parts of what has to be done under the licence and not all or major parts. Furthermore, exempted activities can not include security measures and activities for storage and disposal of nuclear material or waste.

Regulations on Physical Protection of Nuclear Facilities (SSMFS 2008:12)
These regulations contain requirements on organisation of physical protection, clearance of staff, tasks for the security staff, central alarm station, perimeter protection, protection of buildings, protection of compartments vital for safety, access control for persons and vehicles, protection of control rooms, communication equipment, search for illegal items, handling of information about the physical protection and IT-security. Design details about the physical protection shall be reported in a secret attachment to the SAR of the facility.

Regulations and General Advice on the handling of Ashes Contaminated by Caesium-137 (SSMFS 2008:16)
These regulations are applicable for the production of energy by forest bio fuels in incineration facilities that produce a yearly volume of 30 tons of ashes or more. The regulations contain precautionary provisions regarding the handling of ashes for different options, such as returning the ashes to the forests for nutrition, spreading the ashes on agricultural and grazing lands for nutrition, reusing the ashes as road- or landfill and for the design of the waste disposal site if the ashes are deposited.

Regulations on the Planning Before and During Decommissioning of Nuclear Facilities (SSMFS 2008:19)
These regulations contain provisions concerning decommissioning planning and other administrative measures, e.g. documentation before and during decommissioning and reporting to the regulatory authority at different stages of a facility's life cycle.

Regulations on the Handling of Radioactive Waste and Nuclear Waste at Nuclear Facilities (SSMFS 2008:22)
These regulations contain provisions on predisposal management, e.g. on planning and quality assurance of radioactive waste management, on documentation and registration of radioactive wastes, and also for reporting to the SSM.

Regulations on the Protection of Human Health and the Environment from Discharges of Radioactive Substances from certain Nuclear Facilities (SSMFS 2008:23)
These regulations contain provisions for releases of radioactive substances from nuclear facilities during normal operation, based on optimization of radiation protection and shall be achieved by using the best available technique (BAT). The optimization of radiation protection shall include all facilities located within the same geographically delimited area. The effective dose to an individual in the critical group of one year of releases of radioactive substances to air and water from all facilities located in the same geographically delimited area shall not exceed 0.1 millisievert (mSv).

Regulations on Radiation Protection Manager at Nuclear Plants (SSMFS 2008:24)
According to these regulations a licence holder shall appoint a radiation protection manager at the facility in order to implement and look after radiation protection conditions issued by the authorities.

Regulations on Radiation Protection of Workers Exposed to Ionising Radiation at Nuclear Plants (SSMFS 2008:26)
These regulations contain provisions on limitation of exposures as far as reasonably achievable, social and economic factors taken into account. For this purpose the licence-holder shall ensure that goals and needed actions for control are established and documented and that needed resources are available.

Regulations and General Advice on the Protection of Human Health and the Environment in connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste (SSMFS 2008:37)
These regulations apply to disposal of spent nuclear fuel and nuclear waste. They are not applicable for low-level nuclear waste landfills. The basic requirement is that human health and the environment shall be protected from detrimental effects of ionising radiation, during operation as well as after closure. Another important requirement is that impacts on human health and the environment outside Sweden's borders may not be more severe than those accepted in Sweden. The regulations contain provisions on e.g. BAT and optimization, risk criterion and most exposed group, time periods for the risk analysis and, compliance demonstration for different time periods.

Regulations on Filing at Nuclear Plants (SSMFS 2008:38)
These regulations apply to the filing of documentation that is drawn up or received in connection with the operation of nuclear plants. Certain documentation has to be filed. If the practice ceases, the archives shall be transferred to the National Archives of Sweden.

Regulations on Clearance of Goods and Oil from Nuclear Facilities (SSMFS 2008:39)
These regulations contain provisions for clearance of contaminated goods and oil for unrestricted use or for disposal as conventional non-radioactive waste.

Regulations on Basic Provisions for the Protection of Workers and the Public in Connection with Work with Ionising Radiation (SSMFS 2008:51)
These regulations are general and apply to the exposure of workers and the public in both planned and emergency exposure situations. They are based on European provisions in the EU BSS[1]. They contain fundamental requirements on the licensee/operator for justification of the activities, optimisation of the radiation protection and limitation of individual doses (dose limits). They address the categorisation of workers and work places; stipulate Swedish dose limits for workers (including apprentices) and the public, and address the required information and protection of pregnant or breast-feeding women.

The regulations address dose-limitation in connection with emergency exposure situations. They provide rules for measurements and registration of individual radiation doses and how these should be reported to the national dose register.

[1] Council Directive 96/29/Euratom of 13 May 1996, laying down basic safety standards for the health protection of the general public and workers against the dangers of ionising radiation [O. J. L-159 of 29.06.1996].

They contain provisions on medical surveillance, classification and medical records of workers as well as on rules for the accreditation of laboratories for individual dose monitoring and performance requirements of individual dose meters. The regulations refer to the European technical recommendations for monitoring individuals exposed to external radiation (EUR 14852 EN, 1994).

Regulations on Outside Workers at Work with Ionising Radiation (SSMFS 2008:52)
These regulations apply to outside workers of category A, working within controlled areas in Sweden and when Swedish workers of category A perform similar tasks in other countries. The regulations put obligations on both the licensee (e.g. operator of a nuclear facility) and the outside workers undertaking. The regulations contain provisions on procedures to be followed by SSM for issuing individual radiological monitoring documents to outside workers in accordance with the EU Directive (90/641/Euratom).

Regulations on Radioactive Waste Not Associated with Nuclear Energy (SSMFS 2010:2)
These regulations apply to the handling of solid and liquid wastes from medical care, laboratories and science.

E.2.2.4 The Environmental Code

The objective of the Environmental Code is to promote a sustainable development and thereby ensure a healthy environment for current and future generations. The Code includes general provisions on environmental protection. The Code is nuclear activities and activities involving radiation and shall be applied in parallel with the Act on Nuclear Activities and the Radiation Protection Act. The Code is supplemented by a number of ordinances, which are laid down by the Government.

Definitions
In the Code environmentally hazardous activities are defined as:
- the discharge of wastewater, solid matter or gas from land, buildings or structures onto land or into water areas or groundwater;
- any use of land, buildings or structures that entails a risk detrimental to human health or the environment due to discharges or emissions other than those referred to in above bullet or to pollution of land, air, water areas or groundwater; or
- any use of land, buildings or structures that may be detrimental to the surroundings due to noise, vibration, light, ionising or non-ionising radiation or similar impacts.

General rules of consideration
The general rules of consideration assert some important principles that the implementer has to comply with, e.g.:
- The knowledge-principle means that the implementer must possess the knowledge that is necessary regarding the nature and scope of the activity to protect human health and the environment against damage or detriment.
- The precautionary and the BAT principles mean that the implementer shall put

into practice protective measures, comply with restrictions, and take any other precautions that are necessary in order to prevent, hinder or combat damage, or detriment to human health, or the environment as a result of the activity. For the same reason, the best available technology shall be used in connection with professional activities

- The most suitable site-principle means that activities for which land or water areas are used, a suitable site shall be selected taking into account the goals of the Environmental Code. Sites for activities shall always be chosen in such a way as to make it possible to achieve their purpose with a minimum of damage or detriment to human health and the environment.
- The after-treatment liability-principle means that everyone who has pursued an activity that causes damage or is detrimental to the environment shall be responsible, for restoring it to the extent deemed reasonable. The person who is liable for after-treatment shall carry out, or pay for, any after-treatment measures necessary. The general rules of consideration operate as a preventive tool, and to the principle that the risks of environmental impact should be borne by the polluter and not by the environment.

Environmental Impact Assessment (EIA)

The Swedish EIA legislation is in accordance with the Council Directive 85/337/EEC of 27 June 1985, amended by Council Directive 97/11/EC of 3 March and by Directive 2003/35/EC of 26 May 2003, on the assessment of the effects of certain public and private projects on the environment. An EIA shall be submitted together with an application for a permit for environmentally hazardous activities. An EIA shall also be submitted at the prospect of the decommissioning of nuclear facilities.

The purpose of an EIA is to establish and describe the direct and indirect impacts of a planned activity, or measure, on people, animals, plants, land, water, the air, the climate, the landscape and the cultural environment, on the management of land, water and the physical environment in general, and on the management of materials, raw materials and energy. Another purpose is to enable an overall assessment to be made of this impact on human health and the environment.

An environmental impact statement shall contain the following information:

- a description of the activity or measure including details of its location, design and scope;
- a description of the measures being planned with a view to avoiding, mitigating or remedying adverse effects, for example action to prevent the activity or measure leading to an infringement of an environmental quality standard;
- the information that is needed to establish and assess the main impact on human health, the environment and management of land, water and other resources that the activity or measure is likely to have;
- a description of possible alternative sites and alternative designs, together with a statement of the reasons why a specific alternative was chosen and a description of the consequences if the activity or measure is not implemented; and
- a non-technical summary of the information.

Local consultation

In the EIA process the implementer shall consult the county administrative board at an early stage. They shall also consult private individuals who are likely to be

affected by the planned activity, and must do so in good time and to an appropriate extent before submitting an application for a permit and preparing the environmental impact statement. Prior to consultation, the implementer shall submit information about the location, extent, and nature of the planned activity and its anticipated environmental impact to the county administrative board and to any private individuals affected.

If the county administrative board decides that the activity or measure is likely to have a significant environmental impact, an environmental impact assessment procedure shall be performed. In such a procedure the person who intends to undertake the activity or measure shall consult the other government agencies, the municipalities, the citizens and the organisations that are likely to be affected. The consultation shall relate to the location, scope, design and environmental impact of the activity or measure and the content and structure of the environmental impact statement.

Consultation with other countries

If an activity is likely to have a significant environmental impact in another country, the responsible authority as designated by the Government shall inform the responsible authority in that country about the planned activity. This is to give the country concerned and the citizens who are affected the opportunity to take part in a consultation procedure concerning the application and the environmental impact assessment. Such information shall also be supplied when another country that is likely to be exposed to a significant environmental impact so requests.

Licensing and licensing conditions

According to the Environmental Code, a permit is required for environmentally hazardous activities. The Government has in the Ordinance (1998:899) on Environmentally Hazardous Activities and Health Protection stipulated that facilities for the treatment, storage or disposal of spent fuel, nuclear waste or radioactive waste need a permit. A permit is also needed for the decommissioning of nuclear reactors.

The Environmental Court is the first instance for the hearing of cases concerning such activities. In addition the Government has to consider the permissibility of nuclear activities, e.g. the disposal of spent fuel and radioactive waste.

The Environmental Court's judgement when granting a permit for an activity may include provisions concerning supervision, inspections and checks, safety and technical design of the activity and conditions that are necessary to prevent or limit any harmful or other detrimental impact.

Supervision

The purpose of supervision shall be to ensure compliance with the objectives of this Code and rules issued in pursuance thereof. For this purpose the supervisory authority shall supervise compliance with the provisions of the Environmental Code and rules, judgements and other decisions issued in pursuance thereof and take any measures that are necessary to ensure that faults are corrected. The SSM supervise radiation safety issues under the Code.

Sanctions

The supervisory authority may issue any injunctions and prohibitions that are necessary in individual cases to ensure compliance with the provisions of the Environmental Code and rules, judgements and other decisions issued in pursuance thereof.

E.2.2.5 The Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities

The Swedish Parliament has decided on a revised legislation for the financing of the license-holders general obligation according to the Act (1984:3) on Nuclear Activities. The Act (1992:1537) on the Financing of Future Expenses on Spent Nuclear Fuel etc. is replaced since January 1 2008 by the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities.
The general obligations stated in the Act (1984:3) on Nuclear Activities are applicable on all nuclear activities that require a license and the reasoning behind the new Financing Act is that all licensees should secure the financing of these obligations. The primary purpose of the Swedish financing system is to secure the financing of the licensees' costs to handle and dispose the residual products, decommission and dismantle the nuclear facilities and to carry out the needed research and development activities, but also to minimise the State's risk of being forced to bear the costs which is considered to be the licensee's liability.
The revised legislation is in essential parts the same for all licensees and is binding until the obligations stated in the Act (1984:3) on Nuclear Activities have been fulfilled or exemption from them has been granted.

Definitions
The definitions of nuclear facility, nuclear reactor, nuclear material and nuclear waste are those according to the Act (1984:3) on Nuclear Activities. For the purpose of the act:

Residual product is defined as:
- nuclear materials that will not be used again
- nuclear waste which is not operational waste

Nuclear waste fee is defined as the fee for:
- the licensees costs for safe handling and disposal of residual products,
- the licensees costs for safe decommissioning and dismantling of nuclear facilities,
- the licensees costs for research and development needed for these activities,
- the State's costs for research and development needed to review these measures,
- the State's costs for administration of funded means and review of measures taken according to the financing act,
- the State's costs for supervision of safe decommissioning and dismantling of nuclear facilities,
- the State's costs for review of issues relating to disposal ,and surveillance and control of a disposal,
- the licensees, States' and municipalities costs for information to the public concerning handling and disposal of spent nuclear fuel and nuclear waste,
- the costs for economical support to non-profit-making organisations for efforts in connection to the siting of facilities for handling and disposal of spent nuclear fuel.

Obligation to pay the nuclear waste fee and provide guarantees
The licensee of a nuclear facility which generate or has generated residual products shall pay a nuclear waste fee. The fee shall cover the licensee's share of the total costs.
The licensee of a nuclear power reactor must pay a nuclear waste fee. For other licensees there is a possibility to allow exemption to the obligation to pay a nuclear waste fee if the licensee provides a guarantee to cover its costs.
In addition to the obligation to pay a nuclear waste fee, the licensees shall also provide guarantees. The purpose of the guarantees is to ensure adequate reserves for future financing if funded means should be proven inadequate.
The obligation to pay the nuclear waste fee and provide guarantees will end when the licensee have accomplished its obligations according to the Act (1984:3) on Nuclear Activities or been given deliverance from them.

Administration of funds
The fees are collected in a fund, the Nuclear Waste Fund. The Nuclear Waste Fund is an external and governmentally controlled and administered fund.

The financial risk of the State
If it is needed, to serve the purpose of this Act, the financial risk of the State shall be established.

Obligation to pay a risk fee
If a financial risk has been established a risk fee may, in addition to the obligation to pay the nuclear waste fee, be imposed on the licensee. The risk fee shall not be set higher than what is necessary to protect the State from its financial risk.

Usage of funds and guarantees
The accumulated funds shall be used solely to reimburse for the costs which the nuclear waste fee is intended to cover. If the Nuclear Waste Fund is proven inadequate the guarantees shall be used to cover the costs.
If Fund assets remain for a fee-liable licensee after all costs relating to that specific licensee have been paid, the excess of funds shall be paid back to the licensee or the payer.

Supervision
A licensee is obligated to submit cost estimates and other information which might be required to fulfill the purpose of the financing act.

Sanctions
A licensee who intentionally or with grave negligence disregards its obligations by submitting incorrect information will be ordered to pay a fine, unless the action is punishable under the Penal Code.

The Ordinance (2008:715) on Financial Measures for the Management of Residual Products from Nuclear Activities

Cost estimates
The legislation requires the licensees to submit, every three years, estimates of all future costs for management and disposal of spent nuclear fuel and nuclear waste, and decommissioning. The licensee of a nuclear power reactor shall base their costs estimates on 40 years of operation with a minimum remaining operating time of 6 years. The licensee of a nuclear facility other than a nuclear power reactor shall base their cost estimates on the expected remaining period of operation.

The cost estimates are submitted to SSM where they are reviewed. SSM shall for each of the reactor licensees prepares a proposal of the nuclear waste fee the reactor licensee shall pay the following three calendar years.

SSM shall prepare the proposal:
- based on the cost estimates,
- taking into account the total added cost[2], and
- so that all expected costs, after taking into account what has already been paid, is expected to be covered by the fees that the reactor licensee will pay during the remaining operating period of the reactor.

SSM may order a license holder, if there are special reasons, to submit a cost estimate earlier than within three years or to submit an additional cost estimate. If a supplementary cost estimate has been submitted or if there are special reasons for doing so, the SSM may propose nuclear waste fees for a period of less than three years. For licensees of a nuclear facility other than a reactor the SSM may decide on nuclear waste fees for a period of less than three years.

Guarantees
In addition to pay a fee on nuclear energy generation to the Nuclear Waste Fund the nuclear power reactor licensees must provide two forms of guarantees. One guarantee shall cover the discrepancy between funded means and estimated costs. The other type of guarantee shall cover unforeseen contingencies and be available until all reactors have been decommissioned and all nuclear waste has been disposed of in a disposal facility. This guarantee will be used if expenses for future costs become higher than expected, if these expenses have to be met earlier than expected, or if the actual amount in the fund is lower than estimated.
Also the licensee of nuclear facilities other than nuclear power reactors shall provide a guarantee to cover the discrepancy between accumulated funds and estimated costs.

Management of fees
The assets in the Nuclear Waste Fund shall be managed to ensure a good return and satisfactory liquidity. The Nuclear Waste Fund's assets shall be deposited in an interest-bearing account at the National Debt Office, in treasury bills issued by the state or in covered bonds. The return on the fund's assets shall be added to the capital.

[2] *The added costs are the cost of the State, municipalities and non-profit organisations.*

Risk assessment and risk fee
The Swedish National Debt Office shall every three years establish the State's credit risk for the provided guarantees. The National Debt Office may decide that a licensee of a nuclear power reactor shall pay a risk fee corresponding to the State's credit risk if the credit rating of the provided guarantees is assessed to be below the recommended level. The risk fee shall be paid to the Swedish National Debt Office.

Disbursements to licensees
The licensees are entitled to disbursements, on a continuous basis, for expenses which they have already incurred for measures to achieve the decommissioning, handling and disposal of spent nuclear fuel and nuclear waste, including the research needed for these activities. The remainder of the funds is accumulated for future needs. The financial resources should only be used for the purpose they have been established and managed.

Disbursement to municipalities
Municipalities where there are site investigations of the disposal facility for spent nuclear fuel, or where a facility for such a disposal facility is planned or being built, are entitled to compensation from the Nuclear Waste Fund for their information to the public. Disbursements may be determined to no more than 5 million per municipality and twelve-month period. Currently the municipalities of Östhammar and Oskarshamn are receiving disbursements from the Nuclear Waste Fund

Disbursement to non-profit-making organisations
According to the Government's bill (2003/04:116) the issue of disposal of spent fuel and radioactive waste is one of the most complex issues in our time where science and technology meets social science and humanistic issues. The bill concludes that the complexity of the issue requires comprehensive evaluation as a basis for future decisions involving all stakeholders in the society. In 2004 the Parliament therefore approved new regulations in the Financing Act, which made it possible for non- profit-making organisations to apply for financing.

To get financing the non-profit-making organisations must have at least 1000 members, a democratically elected board and a charter of the association, which is decided by the associations' assembly. Support may be provided with a total amount of 3 million SEK per calendar year and with a maximum of SEK 2.5 million per organisation and calendar year.

The non-profit-making organizations are entitled to financial support from the Nuclear Waste Fund until 12 months after the Environmental Impact Assessment has been announced by the Environmental Court.

Supervision of the overall system
The Swedish Radiation Safety Authority reviews the cost estimates according to the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities. The Government sets the fees and guarantees for the licensees of nuclear power reactors. The Swedish Radiation Safety Authority sets fees and guarantees for the licensees of nuclear facilities other than nuclear power reactors.

The Swedish Nuclear Waste Fund (former known as the Board of the Swedish Nuclear Waste Fund) administrates and manages the collected fees.

The Swedish National Debt Office administrates and manages the guarantees.

The Swedish Radiation Safety Authority decides on the disbursement of funds to the nuclear licensees, the municipalities and the non-profit-making organisations. However, certain minor amounts are decided by the Government. Furthermore, the Swedish Radiation Safety Authority is responsible to control that the nuclear utilities have made their payments to the Fund and also to audit the disbursements.

E.2.2.6 The Act (1988:1597) on Financing of Certain Radioactive Waste etc. (the Studsvik Act)

As of 1989, a special fee has been levied on the nuclear power utilities according to a special law, the Act (1988:1597) on Financing of Certain Radioactive Waste etc. This fee is intended to cover expenses for the management of nuclear waste from older experimental facilities.

In conjunction with the decision by the Swedish Parliament on new legislation for the financing of the license-holders general obligation according to the Act (1984:3) on Nuclear Activities, the Parliament also decided that the Studsvik Act should be cancelled by December 31, 2009. During the reassessment of the fee level in 2008 it became evident that remaining year of payments into the fund would not be sufficient to cover estimated costs. Therefor the Government decided to prolong the time period for contributions to the fund according to the Studsvik Act to January 1, 2012.

In 2009 the Government commissioned SSM to investigate future costs, uncertainties and responsibilities, and to evaluate in-depth the problems and financial risks that may arise if the Studsvik Act (1988:1597) was to expire on 1 January 2012. The mission also included, if the SSM found it appropriate, to propose constitutional amendments.

SSM submitted its report to Government in March 2010. The SSM assessment resulted in the conclusion that the combined impacts of the uncertainties, that have been identified, are expected to lead to a future need of funds higher than indicated in the current cost estimates. Furthermore, if the contributions to the fund according to the Studsvik Act would cease, the economic risk of the state would increase. The assessment of SSM is that the Studsvik Act should remain in force until further notice. If payments under this Act are to cease, the quality of the cost estimates must improve significantly.

In June 2011 the Parliament approved a Government Bill (2010/2011:126) containing a proposal to extend the obligation to pay fees under the Studsvik Act until December 31, 2017. The reformed legislation will enter into force on 1 January 2012.

Obligation to pay a fee according to the Studsvik Act

A fee shall be paid to the State as a contribution to costs of the following measures:

- decontamination and decommissioning of the research reactors R2 and R2-0 in Studsvik and associated buildings,
- decontamination and decommissioning of the district heating nuclear power reactor in Ågesta,
- decontamination and decommissioning of the central active laboratory (ACL

& ACF), hot cell laboratory (HCL), van der Graaf laboratory, incinerator facility (HA), treatment facility for intermediate level waste (HM), storage facility (FA), storage facility for intermediate level waste (rock cavity) (AM), dry storage facility for solid intermediate waste (AT), facility for liquid waste treatment (TS), waste storage facility (AU), waste storage facility (UF), waste storage facility (AS 1-4), waste storage facility (UA) and evaporation facility (ID)

- management and disposal of nuclear waste, nuclear and other radioactive waste which has been generated by 30 June 1991 as a result of nuclear activities or stored at the nuclear facilities referred to above,
- management and disposal of nuclear fuel from research reactor R1 in Stockholm and district heating nuclear power reactor in Ågesta and the fuel elements from research reactor R2 in Studsvik on 30 June 1991, there were adjacent to the reactor,
- restoration of the plant in Ranstad a result of past conducted nuclear activities, and
- radiation protection measures which by law is necessary as a result of the activities referred to above.

Licensee who operates a nuclear reactor is liable to pay a fee according to the Studsvik Act. The fee is 0.003 SEK per kWh of electricity generated by nuclear power. The fees are collected in a fund, the Studsvik Fund. The Nuclear Waste Fund administers the Studsvik Fund and the fund is managed together with the funds accumulated according to the Financing Act.

Cost estimates
An entity who is licensed under the Act (1984:3) on Nuclear Activities to the activities governed by this law - or with the consent of SSM other entity - shall submit an estimate of the costs.
The estimated costs shall include both an estimate of the costs of all the measures that can be considered to be necessary, and a breakdown of the costs of the action to be taken within the next three years. The cost estimate shall be updated annually and submitted to SSM annually.

Disbursements
Fee paid under this Act may only be used to reimburse costs for activities listed. The remainder of the funds is accumulated for future needs. The Swedish Radiation Safety Authority decides on the disbursement of funds.
If there are any excess of funds as the last activity is completed, the surplus Studsvik fees in the Fund go to the state.

Supervision and Sanctions
The licensee of a nuclear power reactor and the licensee obligated to estimates costs shall at the request of SSM provide the information and the documents necessary for SSMs activities under this Act.

A licensee who intentionally or negligently provides incorrect information or otherwise act contrary to their obligations will be ordered to pay a fine, unless the act is punishable under the Penal Code.

E.2.2.7 Other Relevant Acts

The Act (2000:1064) on the Control of Dual-use Items and Technical assistance
The export of nuclear material and equipment is governed by the Act on the Control of Export of Dual- use Products and Technical Assistance, as well as by Council Regulation (EC) No 428/2009 of 5May 2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items. (See also information under Article 27, Section I.1.1)

The Civil Protection Act (2003:778)
The Civil Protection Act contains provisions as to how the community rescue services shall be organised and operated. According to the act, the County Administrative Board is responsible for the rescue operations in cases where the public needs protection from a radioactive release from a nuclear installation or in cases where such release seems imminent. The Act also stipulates that a rescue commander with a specified competence, with far-reaching authority, is to be engaged for all rescue operations. In addition the Act requires the owner of hazardous installations to take measures necessary to minimise any harm to the public or environment if an accident were to occur in the installation.

The Civil Protection Ordinance (2003:779) contains general provisions concerning emergency planning. The County Administrative Board is obliged to make a radiological emergency response plan. The Swedish Rescue Services is responsible, at the national level, for the co-ordination and supervision of the preparedness for the rescue services response to radioactive release. The Swedish Radiation Safety Authority decides on necessary measures for the nuclear installations.

The Occupational Safety and Health Act (1977:1160)
The Occupational Safety and Health Act contain requirements about the work environment and provisions on protection from accidents caused by technical equipment, dangerous materials or other work conditions. The Act also contains detailed rules concerning responsibility and authority with respect to occupational safety issues.

The Act on Transportation of Hazardous goods (206:263)
The Act concerning the Transportation of Hazardous goods and the Ordinance (2006:311) on the Transportation of Hazardous goods contains provisions in order to prevent, hinder and limit the damage caused by transport of dangerous goods.

E 2.3 National Safety Requirements and Regulations

This section describes the legislative and regulatory system that has been established in Sweden comprising a system for licensing, the possibility to revoke a licence, prohibit activities, institutional control, regulatory inspection, documentation and reporting, enforcement of regulations, the terms of a licence and the clear allocation of responsibilities of the bodies involved.

E.2.3.1 Licensing

This section describes the licensing system for the treatment and disposal of spent fuel, radioactive waste, very low radioactive waste and non-nuclear radioactive waste. In this context the system of release is also mentioned.

Facilities for the management and disposal of spent fuel and radioactive waste

General

The licensing is issued in accordance to several acts with different purposes and involves a number of authorities. A general permissibility consideration has to be made as to whether to grant a permit for the activity or not. Furthermore the activity shall be approved according to aspects of radiation safety, and the protection of human health and the environment. Finally licensing conditions are set up according to the various acts by the responsible authorities.

An important instrument during the licensing process is the Environmental Impact Assessment (EIA). Early consultation with private individuals likely to be affected, and with government agencies, the municipalities, and the organisations concerned, is emphasised in the Swedish EIA legislation. The consultations shall relate to the location, scope, design and the environmental impact of the activity and to the content and structure of the environmental impact statement (EIS). If an activity or measure is likely to have a significant environmental impact in another country, the responsible authority designated by the Government shall inform the responsible authority in that country about the planned activity or measure and give the country concerned and the citizens who are affected the opportunity to take part in a consultation procedure concerning the application and the environmental impact assessment.

Permissibility

According to the Environmental Code (1998:808) the Government shall consider the permissibility of certain activities such as interim storage or the disposal of spent fuel or waste. An environmental impact statement shall be submitted for the permissibility assessment. The Environmental Court reviews an application on permissibility, which thereafter is handed over to the Government for the final consideration.

According to the Environmental Code the Government may decide on the permissibility only if the concerned Municipality Council agrees that the activities may be located in the municipality (municipal veto). But without prejudice to the municipal approval the Government may permit an activity that involves interim storage or disposal of spent fuel or waste, if the activity is of the utmost importance with regard to the national interest. However, this shall not apply where another site is considered to be more appropriate for the activity, or if an appropriate site has been designated for the activity in another municipality that is likely to approve the activity.

Licensing approval

If the Government grants permissibility according, licensing approval has to be issued for the nuclear activity according to the Act on Nuclear Activities and the environmentally hazardous activity according to the Environmental Code. The Government (or the authority appointed by the Government) grants a licence. in accordance with the Act on Nuclear Activities. The application is reviewed by the regulatory authority assigned by the Government and thereafter handed over for the Government's decision. A permit under the Radiation Protection Act is not required for activities covered by the Act. Finally the Environmental Court grants the licence on environmentally hazardous activities according to the Environmental Code.

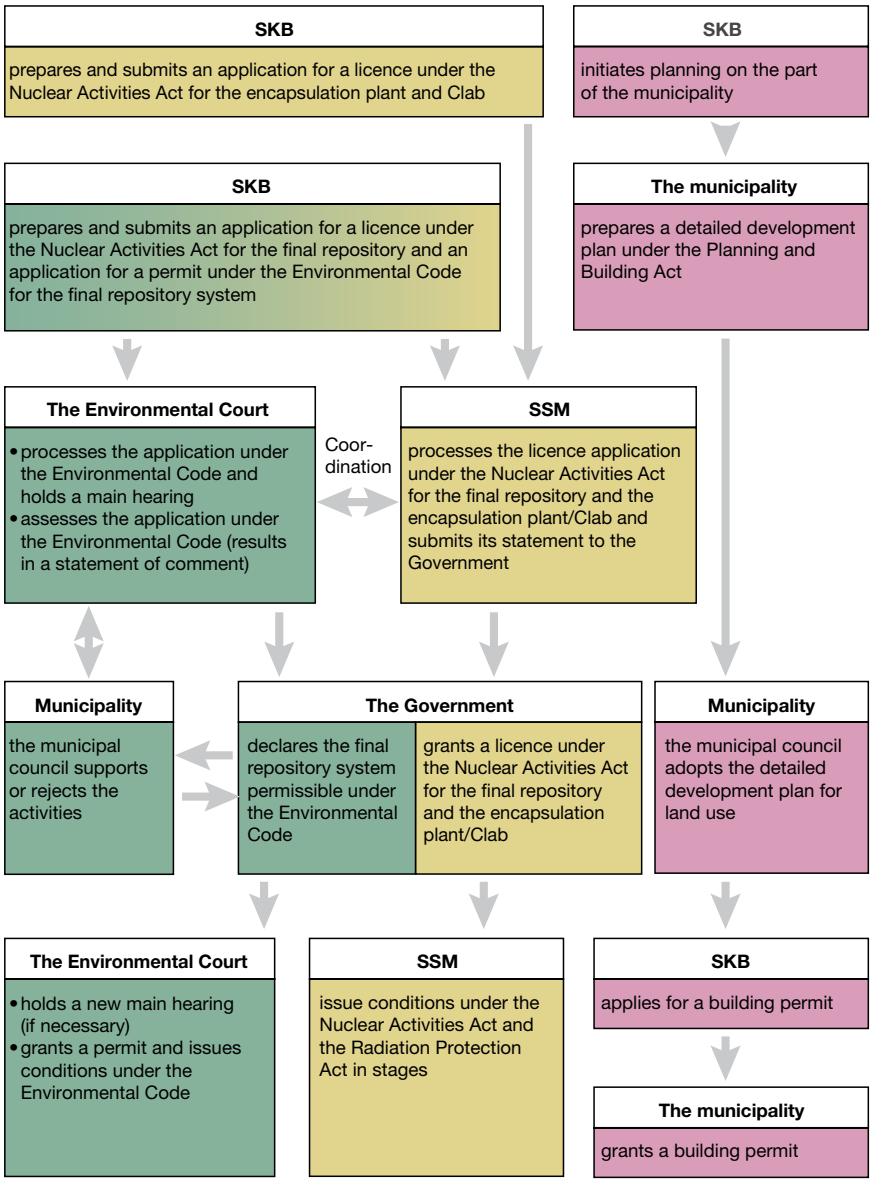


Figure E1: Licensing procedure for the KBS-3 system as presented in RD&D-programme 2007.

Shallow land burials

General
Shallow land burial for very low-level radioactive waste from nuclear activities, is used in Sweden (the highest accepted level according to the legislation is 10 TBq, of which a maximum of 10 GBq may consist of alpha-active substances). The licensing procedures for such a disposal facility differ from the disposal for spent fuel, in so much as there is no need for a Governmental permissibility consideration: it is sufficient with approval from the responsible authorities.

Licensing approvals
In the Act on Nuclear Activities shallow land burial for very low-level radioactive waste is defined as nuclear activity and consequently has to be licensed according to that act. The regulatory authority assigned by the Government grants licences for shallow land burials according to the Act on Nuclear Activities. Furthermore, a shallow land burial is defined as an environmentally hazardous activity and has to be approved in accordance to the Environmental Code by the Environmental Court.

Licensing conditions
Licensing conditions can be issued under the Act on Nuclear Activities, the Radiation Protection Act and the Environmental Code. This means that the Swedish Radiation Safety Authority and the Environmental Court can issue the conditions necessary from specific aspects concerning nuclear safety, radiation protection and environmental protection respectively. The conditions could be issued in connection with such approvals or during the period of validity of the permits.

Radioactive waste from medical use, research and industry
For radioactive waste from medical use, research and industry a licence is required according to the Radiation Protection Act and the Environmental Code.

Release
Release of nuclear materials or nuclear waste must be in accordance with the Act on Nuclear Activities as well as with the Radiation Protection Act, and approved by the regulatory authority. Material may be cleared for unrestricted use, or for disposal as conventional non-radioactive waste. A licence according to the Environmental Code, as is applicable for non-radioactive waste, may be needed if material that has been ”cleared” is to be disposed of as non-radioactive waste.

E.2.3.2 Prohibition

It is prohibited to carry out nuclear activities or activities involving radiation without a permit. Any person who deliberately, or through negligence, operates an activity without the necessary permits shall be fined or sentenced to not more than two years imprisonment. The same penalty (for unauthorised environmental activity) applies according to the Environmental Code.

E.2.3.3 Institutional control, regulatory inspection and documentation and reporting

Institutional control

According to regulations on radiation protection[3] the licence-holder shall conduct environmental monitoring. All discharges from facilities for storage or disposal of radioactive waste shall be monitored by a nuclide specific measuring programme. The dose to any individual in the critical group shall not exceed 0.1 mSv/y. The regulations are applicable to facilities in operation, but will be amended in due time to deal with the period following closure of a disposal facility for spent nuclear fuel and radioactive waste.

The regulatory authority has also issued conditions regarding institutional control of existing shallow land disposal facilities. The regulations stipulate that institutional control shall continue until the radioactivity no longer is a ”significant” hazard to public health and the environment. The municipalities' detailed development plans are also of importance, by providing conditions concerning the use of the land. All nuclear facilities, including shallow land disposals are within areas where detailed development plans have been established.

Regulatory inspection

In accordance with legal authorisation and the mandate defined by the Government[4], the regulatory authority conduct regular inspections and assessments of the Swedish nuclear facilities to ascertain compliance with regulations and licence conditions.

The supervision of the compliance with the Act on Nuclear Activities and the Radiation Protection Act, as well as conditions or regulations imposed under the acts, is executed by the regulatory authority assigned by the Government, which is SSM. SSM also fulfils supervision of the compliance with the Environmental Code and conditions or regulations imposed by the Code for questions concerning radiation safety. For other areas covered by the Code the County Administrative Board conduct supervision.

On request the implementer shall submit to the authority information and provide the documentation required for its supervision. The authority shall also be given access to the installation or site where the activities are conducted, for investigations and sampling, to the extent required for supervision (see also sections E.2.2.1 and E.2.2.2).

[3] *Regulations on the Protection of Human Health and the Environment from Discharges of Radioactive Substances from certain Nuclear Facilities (SSMFS 2008:23)*

[4] *Ordinance (2008:715) on Financial Measures for the Management of Residual Products from Nuclear Activities.*

SSM practices
SSM has since the authority was established developed its supervision methods in several projects. A first phase was completed at the end of 2009. Policies for inspections and new routines, as part of the general SSM management system, were gradually established during 2009. In a second phase, which started during 2010, harmonization between procedures in different supervision areas, as well as further development of the supervision procedures will take place. The following list exemplifies (not complete) relevant documents from the SSM management system:

1.	Supervision policy	2010-08-24
2.	To inspect	2009-09-21
3.	To conduct minor inspections	2009-09-21
4.	Access rules to facility's under the authority's supervision	2009-05-19
5.	Integrated safety assessments	2009-12-11
6.	Sanctions related to the SSM supervision and control	2009-05-25
7.	To control nuclear power plant environmental monitoring programme	2010-01-14

The following describes the SSM supervision practice (for nuclear installations) during 2008 and 2009, after the Swedish Radiation Safety Authority was established.

In total 17 areas are defined for which the corresponding requirements are found in regulations, licensing conditions and to some extent in regulatory decisions. The ambition is to successively cover these areas in a basic inspection programme and to document the inspection findings. Moreover, the same 17 areas are used in the annual assessments of the licensees (SSM integrated safety assessments, see below) as well as in the periodic, 10-year safety reviews. Like this, the SSM is able to maintain a systematic picture of the safety situation and to monitor the development. When new assessments start, already performed and documented assessments of the areas can be consulted and any emerging picture be consolidated. The idea is to use the regulatory information and knowledge in a more efficient way. In order to further guide inspections and safety assessments there is also a sub-structure in each of the 17 areas. The used areas are:

1. Design and construction of facilities, including modifications
2. Organisation, management and control of the nuclear activity
3. Competence and staffing of the nuclear activity
4. Operations, including handling of deficiencies in barriers and the defence-in-depth
5. Core and fuel issues and criticality issues
6. Emergency preparedness
7. Maintenance, including materials- and control issues with special consideration of degradation due to ageing
8. Primary and independent safety review, including the quality of notifications to SSM
9. Investigation of events, experience feedback and external reporting
10. Physical protection
11. Safety analyses and safety analysis report
12. Safety programme

13. Archiving, handling of plant documentation
14. Management of nuclear material and radioactive waste
15. Nuclear non-proliferation, exports control and transport safety
16. On-site radiation protection
17. Radiation protection of general public and the environment

As a result of assessments within these areas, safety conclusions can be drawn in terms of the integrity of the physical barriers and the functioning of the five levels of the defence-in-depth. In the regulations SSMFS 2008:1 the areas 1-15 are found in the general advice section (section 4, 4 §) on periodic reviews of the nuclear safety. The licensees are encouraged to analyze and report on their activities according to these areas. The added areas 16 and 17 cover issues regulated by the Radiation Protection Act (SFS 1988:220).

Documentation and reporting
According to the annual letters of appropriation, government decisions, acts and ordinances, regulatory authorities are required to submit the following reports concerning regulatory activities to the Government on a regular basis:

- In an Annual Activity Report, the authority is required to summarise results, effects and costs of the regulatory activities, in accordance with general regulations issued by the Government and the Swedish National Audit Office for such annual reports issued by all government authorities.
- An annual Report on the Status of Safety and Radiation Protection at the Swedish nuclear power plants. The central interim storage for spent nuclear fuel (Clab) and the disposal facility for operational waste (SFR) are included in the report. The report summarises important findings and conclusions from operational experience and regulatory inspections and reviews, both with regard to the technical safety status of the plants and the quality of the safety work at the plants, as well as on occupational and environmental doses and other radiological data.
- At least once in every ten years, licensees are required to perform a periodic safety review (PSR), i.e. an integrated analysis and assessment of the safety of a facility. The periodic safety reviews are submitted to the regulatory authority, which makes a comprehensive review and assessment of the submitted review and its references, which is documented in a review report. In the case of nuclear power reactors, the report is submitted to the Government.
- Every three years, the regulatory authority is required to submit a Review Report on the Nuclear Industry Research, Development and Demonstration Programme on Disposal of Spent Fuel and Nuclear Waste and the Dismantling and Decommissioning of Nuclear Installations (the SKB RD&D-programme), to the Government. In addition to the findings, conclusions and recommendations as to the purposefulness and quality of the programme, the review report also proposes conditions for the future conduct of the SKB RD&D-programme that the Government may wish to prescribe in accordance with the Act on Nuclear Activities.
- Every three years, the regulatory authority appointed by the Government is required to submit a proposal for the nuclear waste fees to be paid by the licensees of nuclear power reactors to cover the costs for the disposal of spent fuel and nuclear waste and the dismantling and decommissioning of nuclear

installations. The regulatory authority also includes a review report on the cost estimates provided by the licensees.
- The regulatory authority assigned by the Government shall on an annual basis report to the Government on the licences granted concerning export, import or the transit of nuclear waste and the erection, possession or operation of shallow land burial sites.
- The regulatory authority, also issues reports to a number of organisations, such as UNSCEAR, OECD, IAEA, etc. on a regular basis, in agreement with international conventions. The major part of that reporting is within the environmental radiation protection area but some parts also consider occupational radiation protection.

In addition to the above-mentioned reports, the regulatory authority also issues periodic reports to inform the public of major activities.

The regulatory authority also issues reports where R&D results and important regulatory assessments are published. All reports published by the regulatory authority are open to the media and the public.

E.2.3.4 Enforcement of regulations and terms of licences

The authorities have extensive legal regulatory and enforcement power. As described in section E.2.3.2 concerning prohibition, a licence may be revoked for activities that do not fulfil the obligations set out in the legislation. If there is an on-going licensed activity that does not comply with regulations or terms of the licence, the supervisory authorities may issue any injunctions and prohibitions required in the specific case to ensure compliance. Injunctions or prohibitions under the Acts may carry contingent fines.

If a person fails to carry out a measure incumbent upon him under the Acts, Ordinances, regulations or conditions issued pursuant to the Acts, or under the supervisory authority's injunction, the authority may arrange for the measure to be taken at his expense.

E.2.3.5 Clear allocations of responsibilities of the bodies involved

The Swedish legal framework allocates a clear division of responsibilities between the bodies involved. As already mentioned, the producer of spent fuel and radioactive waste has the responsibility to safely handle and dispose of the waste produced. All necessary measures and precautions should be taken by the waste producer. The authorities independently supervise, regulate and review existing or planned activities with spent fuel and radioactive waste.

The ultimate responsibility for ensuring the safety of spent fuel and radioactive waste rests with the State. According to a Government statement, the ultimate responsibility of the State "is a matter of course" and does not need to be implemented in the legislation.

E.2.4 Conclusion

Sweden complies with the obligations of Article 19.

E.3 Article 20: REGULATORY BODY

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.
2. Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation

Summary of developments since the last national report

- The Swedish Radiation Safety Authority (SSM) was formed in July 2008 in a merger between the Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Authority (SSI).
- The Swedish Civil Contingencies Agency (MSB) was formed in January 2009 in a merger between the Swedish Emergency Management Agency (KBM) and the Swedish Rescue Services Agency (SRV).
- SSM competence needs were investigated and reported to the Government in March 2011.
- Increase in SSM staff since 2009 with about 10 % (274 as compared to 246).

E.3.1 Regulatory bodies and their mandates

E.3.1.1 General

The legal basis for the regulatory activities in Sweden is given in a number of legal documents of various types: laws, governmental ordinances, annual government letters of appropriation, and specific governmental decisions, including specific licensing decisions. Through government ordinances and specific decisions, the Government delegates to the regulatory body specific parts of the legal authority given to the Government by the Parliament through legislation.

The Swedish Radiation Safety Authority (SSM) is a central administrative authority under the auspices of the Ministry of the Environment. SSM is the regulatory body in Sweden authorized to supervise spent fuel management and radioactive waste management according to the Act (1984:3) on Nuclear Activities (SFS 1984:3) and the Radiation Protection Act (SFS 1988:220). According to the Swedish constitution, the administrative authorities are quite independent within the legislation and statutes given by the Government. An individual minister cannot interfere in a specific case handled by an administrative authority.

The Government ministries are small units, by comparison with ministries in most other countries. Their main responsibilities are:
(1) Preparing the Government's bills to Parliament on budget appropriations and laws;
(2) Issuing laws and regulations and general rules for the administrative authorities;
(3) International relations;
(4) Appointment of higher officials in the administration; and
(5) Certain appeals from individuals which are addressed to the Government.

The Cabinet of ministers as a whole is responsible for all governmental decisions. Although in practice a large number of routine matters are decided upon by individual ministers, and only formally confirmed by the Government, the principle of collective responsibility is reflected in all forms of governmental work.

The Director General of the Swedish Radiation Safety Authority is appointed by the Government, normally for a period of six years. As all Swedish authorities, the SSM issues an annual activity report to the Government summarizing major results, effects, revenues and costs. The Government carries out follow-up work and evaluates the agency's operations based on this report. In addition, the SSM submits an annual report to the Government on the status and management of nuclear safety and radiation protection at the Swedish nuclear plants. The report summarizes major findings and conclusions on operational experience, regulatory inspections and reviews: technical safety status, radiation protection work, environmental impact, waste management, emergency preparedness as well as organizational matters, safety culture, physical protection and safeguards.

The requirements on SSM and other Swedish authorities for openness and provision of information services to the public, politicians and media are very high. Swedish official documents are public unless a decision is made to classify them according to the Public Access to Information and Secrecy Act (SFS 2009:400). The reasons for secrecy could be those of national security, international relations, commercial relations, or the individual right to privacy. No-one needs to justify a wish to see a public document or to reveal her/his identity to have access to a document.

E.3.1.2 The Swedish Radiation Safety Authority (SSM)

SSM was established on July 1, 2008, and is the national regulatory authority responsibility within the areas of nuclear safety, radiation protection and nuclear non-proliferation.

The SSM missions and tasks are defined in the Ordinance (SFS 2008:452) with instruction for the Swedish Radiation Safety Authority and in the annual letter of appropriation. The Ordinance declares that SSM is the administrative authority for protection of people and the environment against harmful effects of ionising and non-ionising radiation, for issues on nuclear safety including physical protection in nuclear technology activities as well as in other activities involving radiation, and for issues regarding non-proliferation.

SSM shall actively and preventively work for high levels of nuclear safety and radiation protection in the society and through its activities act to:
(1) Prevent radiological accidents and ensure safe operations and safe waste management at the nuclear facilities;
(2) Minimize risks and optimise the effects of radiation in medical applications;
(3) Minimize radiation risks in the use of products and services, or which arise as a by-product in the use of products and services;
(4) Minimize the risks with exposure to naturally occurring radiation; and
(5) Contribute to an enhanced level of nuclear safety and radiation protection, internationally.

SSM shall ensure that regulations and work routines are cost-effective and uncomplicated for citizens and enterprises to apply/understand.

SSM shall handle financial issues connected with the management of radioactive wastes from nuclear activities. The Authority shall inform the Nuclear Waste Fund about the size of payments and disbursements from the fund, planned or forecasted, by each reactor operator or other relevant licensee, and of SSM's own activities regarding financing issues, so that the Nuclear Waste Fund can fulfil its tasks[5]. SSM is in charge of the Swedish **metrology institute** for ionising **radiation.** SSM shall operate a national dose register and, as appropriate, issue national individual dose passports.

SSM shall furthermore:
- Carry out Swedish obligations according to conventions, EU-ordinances/directives, and other binding agreements (e.g. contact point, report drafting, and to be the national competent authority);
- Supervise that nuclear material and equipment is used as declared and in agreement with international commitments;
- Carry out international cooperation work with national and multinational organisations;
- Follow and contribute to the progress of international standards and recommendations;
- Coordinate activities needed to prevent, identify and detect nuclear or radiological events. The SSM shall organise and lead the national organisation for expert advice to authorities involved in, or leading, rescue operations;
- Contribute to the national competence development within the authority's field of activities;
- Provide data for radiation protection assessments and maintain the competence to predict and manage evolving issues; and
- Ensure public insight into all the authority's activities.

The SSM publishes reports to inform interested parties and stakeholders. The SSM website is used for information on current events and authority decisions. In the SSM report series, R&D-reports and central regulatory assessments are published.

[5] The Nuclear Waste Fund is a government authority which manages the fees paid by the power companies and the owners of other nuclear facilities in Sweden.

All reports issued by SSM can be ordered. Most of them are available for download from the SSM website. Since June 2010 SSM issues the periodical "Strålsäkert" (Radiation Safe).

SSM maintains a function on duty "around the clock" to respond to incidents and other urgent matters. In case of severe events, the emergency staff will be mobilised. SSM also has one employee available for press contacts and IT support during outside office hours.

The annual appropriation letter focuses on short-term-issues and funding of the Authority activities. In the appropriation letter for the fiscal year 2011, from December 2010, SSM was for example given the assignment to:

- At latest February 1, 2011 report on how a licensing procedure of new Swedish nuclear power reactors could be formed; in line with the Governments intent to create the requisites for controlled generational shifts of the Swedish nuclear power.
- Identify and report, before April 30, 2011, current safety and radiation safety issues which could be of importance during 2011-2014 when Sweden is a member of the IAEA Board of Governors.
- Report on the level of safety at the Swedish nuclear power plants latest 31 May 2011.

The SSM work can be divided into supervision of the safety and radiation protection work connected with ionising and non-ionising radiation. For ionising radiation, the main regulatory areas are: the use of nuclear technology and power production, the medical sector with therapy and diagnostics, the use of radiation sources and x-ray equipment in industry, the public use of sources and devices in commodities, the use of detectors and scanning equipment for security reasons, the management of radioactive waste, the exposure of ionising radiation from naturally occurring radioactive material (NORM). In this report the focus is on the supervision of the management of spent nuclear fuel and radioactive waste as defined by the Joint Convention.

Figure E2: displays the present organisation of SSM. The international development cooperation work is managed by the Secretariat for International Co-operation and Development reporting to the deputy DG and head of DG staff.

With regards to the supervision of spent nuclear fuel and radioactive waste management, the tasks subject to this report are to a large extent carried out by the Department of Radioactive Materials. However this work is co-ordinated with the activities of the Department of Nuclear Power Plant Safety (safety issues, human factors expertise, and supervision of operating nuclear power plants) and the Department of Radiation protection (radioactive waste and disused sources from non-nuclear facilities and emergency preparedness and response).

The Director General is exclusively responsible for the authority activities and reports directly to the Government. The authority has an advisory council with a maximum of ten members which are appointed by the Government. Those are usually members of the parliament, agency officials or independent experts. The functions of the council are to advise the Director General and to ensure public transparency (insight) in the authority's activities but it has no decision-making powers.

The Delegation for Financial Issues Connected with the Management of Rest

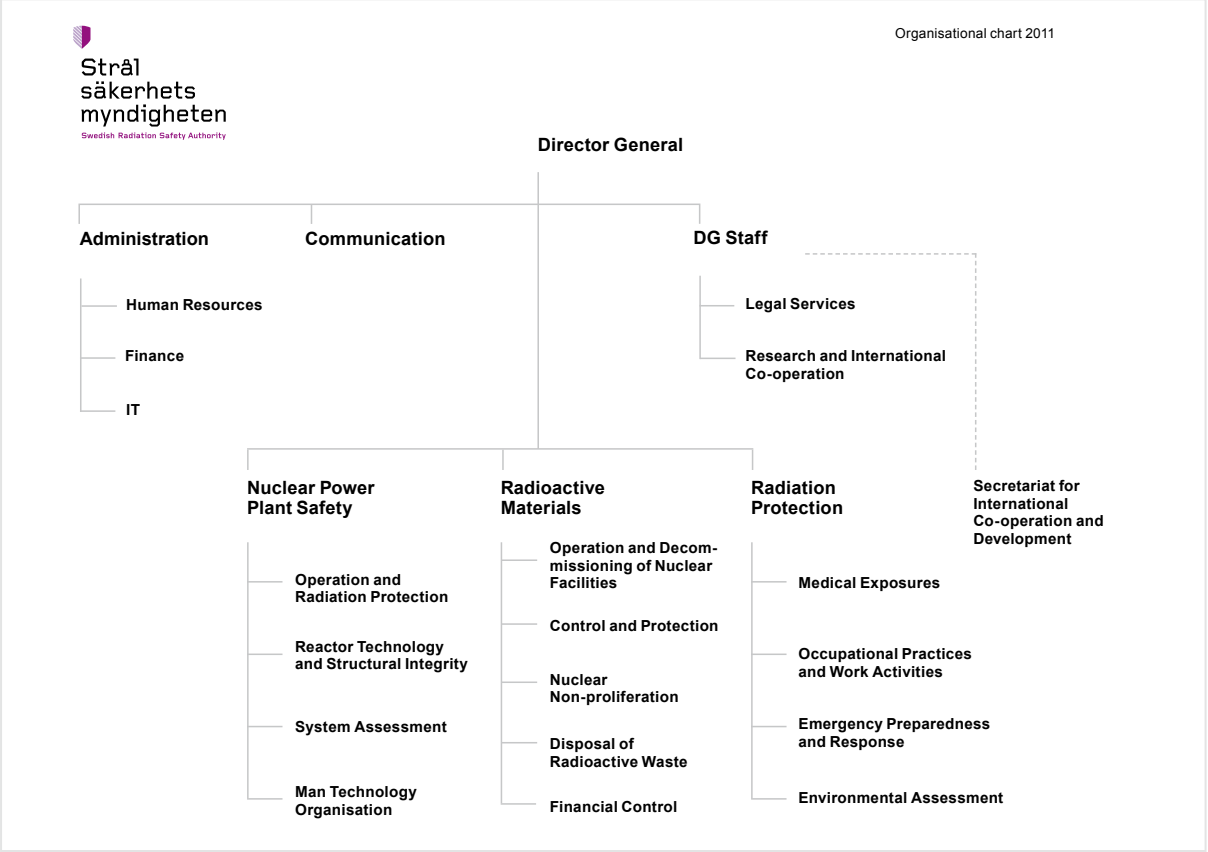


Figure E2: SSM organisation

Products from Act (1984:3) on Nuclear Activitiess as SSM's advisory body in suggesting the fees, and the basis for calculating the fees, to the Nuclear Waste Fund. SSM also proposes the sizes of the supplementary guarantees the utilities must have available. The delegation is led by the Director General and has at most eight other members appointed by the Government which represent other authorities and independent institutions with relevant competence.

SSM also has permanent advisory committees on reactor safety, radioactive waste and spent nuclear fuel management, and research and development, as well as in other fields such as UV, EM fields, and the use of ionising radiation in oncology.

E.3.1.3 The Swedish Civil Contingencies Agency

On January 1, 2009 the Swedish Civil Contingencies Agency (MSB) was formed, merging three earlier central authorities with emergency preparedness, and civil defence responsibilities. The task of the MSB is to enhance and support societal capacities for preparedness for and prevention of emergencies and crisis. The MSB coordinates emergency preparedness funding, off-site emergency work, and oversees the planning of the regional County Administrative Boards. MSB also evaluates on- and off-site emergency exercises and initiates educational efforts.

E.3.1.4 The Swedish Work Environment Authority

The Swedish Work Environment Authority (AV) was established in 2001. The AV's paramount objective is to reduce the risks of ill-health and accidents in the workplace and to improve the work environment in a holistic perspective, i.e. from the physical, mental and organisational viewpoints. The AV is tasked with for example ensuring compliance with work environment legislation.

E.3.1.5 The Swedish National Council for Nuclear Waste

The Swedish National Council for Nuclear Waste was established in 1985, and is an independent committee attached to the Ministry of the Environment. The Council's mandate is to study issues relating to nuclear waste, the decommissioning of nuclear facilities, and to advise the Government and certain authorities on these issues. The Government has authorised the Minister of the Environment to appoint the chairman and up to ten other members. The budget of the Council is decided by the Government and The Council activities are financed through the Nuclear Waste Fund. Members of the Council are independent experts within different areas of importance for the disposal of radioactive waste, not only in technology and science, but also in areas such as ethics and social sciences.

According to its latest Government instructions from April 8, 2009 (Dir.2009:31) the Council shall:

- Assess the research and development programme of the Swedish Nuclear Fuel and Waste Management Company (SKB), license applications and other reports of relevance to the disposal of nuclear waste;
- At latest 9 months after that SKB, according to the 12 Section of the Act on Nuclear Activities (SFS 1984:3), has reported on its R&D-programme, the Council shall present an independent assessment of the research and development activities, and other measures which are presented in the R&D-programme. The Council shall also follow the activities carried out in the area of decommissioning and dismantling of nuclear facilities;
- The Council shall during the month of February report on its activities during the preceding year and give its independent assessment of the situation within the nuclear waste management area.
- The Council shall investigate and illuminate important issues within the nuclear waste management area, inter alia by seminars and public hearings, and create the prerequisites for creating as good foundation as possible for its advice to the Government;
- The Council shall follow the development of other countries disposal programs for spent nuclear fuel and radioactive nuclear waste. The Council should also follow, and when necessary participate in, the work of international organisations as regarding disposal of radioactive nuclear waste and spent nuclear fuel.

E.3.1.6 The County Administrative Boards

The County Administrative Boards exercise supervision according to the Civil Protection Act (SFS 2003:778) and Ordinance (SFS 2003:789), responsible for

planning and implementing rescue operations in cases where the public needs protection from a radioactive release from a nuclear installation or in cases where such release seems imminent.

E.3.2 The Swedish Radiation Safety Authority – human and financial resources

E.3.2.1 Human resources and management system

SSM at the end of 2010 had a staff of 274 persons, an increase with 10 % from 2009. The average age is 47 years and 44 % are women. Of the staff, 24 % were younger than 40 years, 31% between 41 and 50 years, and 44 % older than 50 years. About 15 % of the SSM employees will retire (65 years) within 5 years but some opt to work until the age of 67. Ten persons were older than 65 years at the end of 2010.

During 2010, 42 persons were employed (20 women and 22 men). The staff turnover rate during 2010 was 4 % or 3 % if retirements are excluded. SSM works with a long-term plan for its competence needs and this work will continue during 2011. In March 2011 SSM reported to the Government on the competence situation in the disciplines of importance to the authority; taking into account both the internal and the national needs.

The "steering and supportive sections" of SSM totally accounts for about 45 persons. This includes the DG staff (with legal services), the communication unit, the administrative unit (including human resources unit), the finance unit, and the unit for IT issues.

The educational background of SSM staff in April 2011 is shown in Table E1:

Education	Percentage
Post graduate degree	20
Bachelor/master	63
Secondary high school	15
Other	2
Total	100

Table E1: Educational background of the SSM staff

Compared with many other authorities, the SSM staff has on average a rather high educational level. This is a result of the many specialist areas covered by the authority, and to some extent the fact that there is no technical support organisation (TSO) in Sweden to support the regulatory body with specialist knowledge.

Comparing internationally, the number of regulatory staff in Sweden is small for the size of the nuclear programme. Many staff members are typically involved in several tasks, such as inspections, regulatory reviews and approval tasks, revision of regulations, handling research contracts, and participation in public information activities, each activity requiring his or her expertise. When comparing the sizes of staff between different countries, it is however important not only to count the staff members per reactor, but also to consider the types of legal obligations put on the licensees and the different oversight practices.

Since a couple of years SSM experiences a high workload depending on the safety modernizations of the Swedish reactors, upgrading of the physical protection of the plants, as well as applications to up-rate the power levels of several reactors. This makes it important to implement a good long-term planning and to develop the necessary assessment and administrative tools to deal with the tasks without overloading the staff. Such planning is being carried out. Special procedures were developed for review of the power up-rate applications and the authority presently re-examines its processes for reviews and assessments.

SSM performs internal staff training, organized by the human resources unit. During 2010 about 1700 days – nearly 6 days per employee - were used for such competence development.

During spring 2009 a development program for the management group was finished. The program has contributed to a common view of the authority's tasks and objectives and an increased understanding of the manager position. A new long-term development program for managers has started; it was extended over 2010 and the goal is to strengthen abilities to lead, influence and work towards common objectives.

The SSM has launched a development program on leadership where 10 motivated and suitable co-workers, selected from 55 applicants, will be given the opportunity to prepare for a management career. The education and development program, from September 2010 until May 2011, will in total consist of 25 days or about 15 % of the candidates total working hours.

Introductory training is mandatory for new employees as well as emergency preparedness training for the emergency staff, among those all inspectors. Except for this, the training programme is tailored to meet specific needs in relations to the competence profile of each position. Newly hired personnel vary in knowledge and experience – from those having a solid knowledge about the nuclear power and radioactive waste to those who come directly from the technical high school/ university. Annual dialogues are held between respective manager and staff to assess training and educational needs.

Courses are given on internal processes of the management system, the legal framework for regulatory activities, IT and security routines, project management, inspection methodology, nuclear technology, nuclear power plant- and systems courses, and media training.

About 80 common educational events took place during 2010. Apart from the introductory courses, the following was covered: the use of new administrative tools, communication with media, environment aspects, inspection- and supervision methodology and work environment issues.

The process-based, integrated SSM management system

SSM has a management system which is certified on the issues of environment, quality management and work environment management in accordance with the ISO standards ISO 14001, 9001 and the Swedish Work Environment Authority regulations AFS 2001:1. The management system is integrated and process based. During 2010, the system was supplemented with a section on Information Security following ISO standard 27001. Internal and external revisions are performed yearly.

Before SSM was established, structure and layout of processes and the complementing documents of the regulatory body were extensively discussed. Also, at the beginning, the priority was on overall structure, description of the main processes and the main policy and instructions. The system is still under deve-

lopment. The process map follows an iterative cycle from left to right: Planning process, Implementation process and the Follow-up process. Various support processes and the handling of affairs (diary and archiving) are held together under the name Supporting processes.

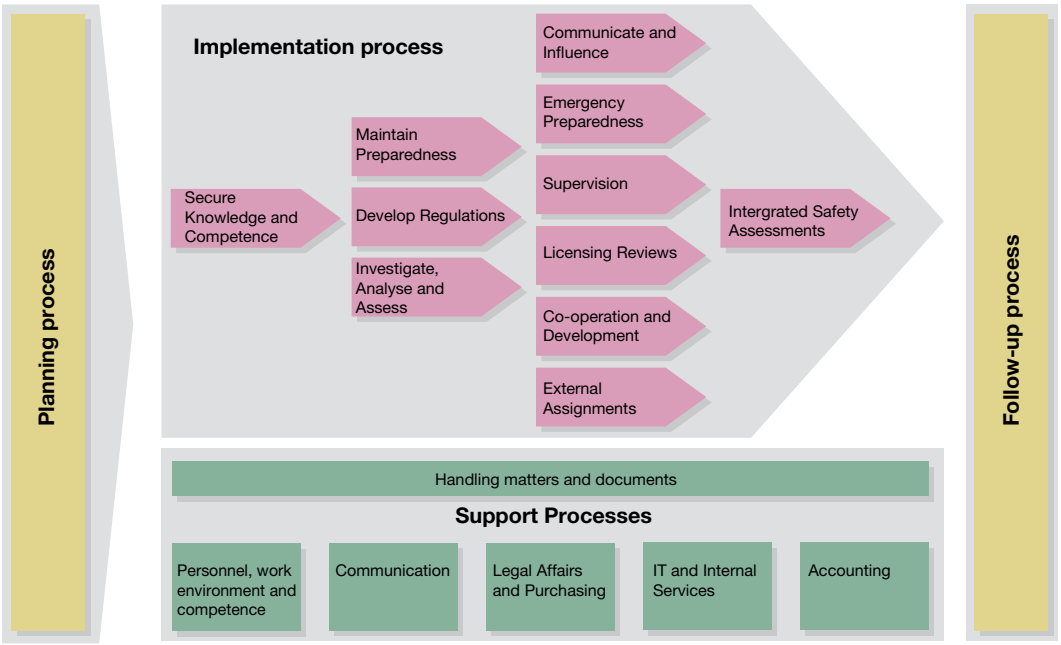


Figure E3: The SSM management system process scheme

Scope of management system

The management system encompasses:

- Over-arching description of the management system
- Mission, shared vision and tasks of the regulatory body
- The management control of the regulatory body (including policy for quality, environment, working environment and information security)
- The authority's main processes for planning, implementation and follow-up as well as supporting processes
- The organisation, tasks and duties (rules of procedure, decision-making and preparation schemes)
- Analyses (environmental scanning, working environment risk analysis, activities, security protection, information security etc. and environmental aspects) and plans of action
- Description and assessment of external interested parties
- External requirements (Ordinance (2008:452) with instructions for SSM, annual Government letters of appropriation, Acts, etc.)
- Environmental inquiry and environmental action plan
- Procedures for document control
- Internal established steering documents
- Accounting documents
- Program and plans for internal and external reviews

- Methods for measuring the impact and effect of each process
- Competence management and education plans
- IT based support displaying processes, supporting documents and relation between processes
- IT based activity management system for planning and follow-up (SINUS

Implementation of audits
SSM ensures that annual internal and external audits of the authority's activities are carried out, in addition to audits of the Swedish National Audit Office. The SSM management system should account for internal and external requirements; the latter such as those of ISO-standards, statutes and legal provisions, e.g. work environment management and information security.

SSM follows a plan of internal auditing for the period 2009-2011. The objective of these internal audits are to follow-up the activities of the Authority on all levels, to check compliance with external and internal requirements, to investigate how the "common values" are integrated in the practical work, and to check if the management system is effective and adapted to its purposes. The internal auditors are appointed by the DG and put together in suitable audit teams; considering experience, competence and audit objectives.

External audits are carried out two times every year. The auditors control how SSM follows the requirements of ISO 9001, ISO 14001, the Swedish Work Environment Authority regulations AFS 2001, and other relevant requirements. The external auditors are accredited by **Swedish Board for Accreditation and Conformity Assessment**, an authority under the **Ministries for Foreign Affairs and Enterprise, & Energy and Communications**.

In February 2012, on request by the Swedish Government, the IAEA will conduct a full-scope IRRS mission in Sweden. A preparatory self-assessment was carried out in the beginning of 2011.

New system for document management
In January 2010 it was decided that SSM should acquire a new document management system to the authority (largely following ISO 15489). The implementation is gradual during a 3-year period and started during 2010 with project work, education of the staff and implementation of some parts. The diary part was introduced in the beginning of 2011. The objective of the new system is to allow for effective handling of documents and applications. External contacts should be able to fully use Internet and e-mail for their dialogue with SSM. A careful scan of the legal requirements (archiving, freedom of the press, public information, secrecy, confidentiality etc.) was performed. The possibility to use electronic signature (procedures for establishing a legal validity of signed documents sent by Internet or e-mail) will be studied.

E.3.2.2 Financial resources

The regulatory activities of SSM are financed over the state budget. The costs are largely recovered from the licensees as fees covering the regulatory activities and the related research. The sizes of the fees are annually proposed by SSM but decided by the Government. Activities connected to the licensing of nuclear waste disposal facilities and the financing of the nuclear waste management system are fun-

ded through the waste management fund. The budgets for 2009, 2010 and 2011, except for the funding of the separately financed international cooperation and development work performed by the Secretariat for International Co-operation and Development, are shown in Table E2.
In addition, some extra resources (at most a few million per year) are fees for reviewing special applications or licensing work, paid directly to the Authority.

Budget Item	2009	2010	2011	Funding source
Nuclear safety, emergency preparedness, radiation protection (including administration)	214,350	233,400	230,450	Mainly fees
Scientific research and development work	90,000	96,000	79,000	Mainly fees
Disposal of spent fuel and radioactive waste	6,000	28,200	70,000	Waste management fund
Historical wastes etc.	2,700	2,000	2,000	Tax funded
Crisis management[6]	29,000	27,000	25,000	Tax funded
Total (kSEK)	342,050	386,600	404,450	

Table E2: Budget of SSM in kSEK - 1 SEK is about 0.1 Euro

Regulatory research
The Swedish Radiation Safety Authority (SSM) decided on its research plan for 2011-2013. Based on what is stated about research in the Ordinance (SFS 2008:452) with instruction for the Swedish Radiation Safety Authority, the main purposes for SSM research is to:

- Maintain and develop the competence of importance for radiation protection and nuclear safety work.
- Ensure that SSM has the knowledge and tools needed to carry out effective regulatory and supervisory activities.

SSM supports basic and applied research and also development of methods and processes (usually not products). However for development work the intention is that the developed method or process should be used solely by the authority, in support of the authority work. One aspect is the clear separation between research and authority support. The latter is not in the interest of the broader society and must be put out to tender.

In order to contribute to national competence and research capacity, SSM and the nuclear industry support the Swedish Centre of Technology within a long-term contract (2008-2013). SSM finances three higher research posts in radiation biology, radioecology and dosimetry until 2013. The University of Stockholm formed the Centre for Radiation Protection Research to co-ordinate Swedish resources in the area.

Nuclear safety research is performed within bilateral agreements with Finland but also within NKS (Nordic Nuclear Safety Research) in two programme areas, Reactor safety and Emergency preparedness. The latter area actually includes waste management research.

To fulfil research needs, SSM contracts universities and consulting companies. A dominating share goes to research organizations in Sweden. However,

[6] *These funds are received via the Swedish Civil Contingencies Agency (MSB)*

since national resources are limited, SSM actively participates in international research. SSM cooperates on research conducted by EU and OECD/NEA and takes part in a large number of projects.

In order to maintain continuity in knowledge and competence in connection with the assessment and examination of the deep geological disposal facility for spent nuclear fuel, SSM has financed suitable research and development work within areas such as canister corrosion, biosphere processes, buffer and refilling, geosphere processes, spent fuel andsafety assessment methodology. Such measures has led to that the SSM is well prepared for a trustworthy examination and assessment of the new waste management facilities the licensees plan to build, commission and operate.

In addition SSM has had research projects connected to decommissioning, e.g. applied studies on actual costs and methodologies for decommissioning and dismantling of nuclear facilities.

The research budget SSM allocated to research related to spent fuel and radioactive waste management 2010 is shown in Table 3.

Research area	Expenditures 2010 (kSEK)
Biosphere processes	2 503
Buffer and refilling	3 613
Canister	2 369
Decommissioning	1 249
Geosphere processes	3 632
Safety assessment methodology	2 716
Spent fuel nuclide chemistry	1 697
Total (kSEK)	**17 779**

Table E3: Breakdown of the 2010 research budget allocated for research related to spent fuel and radioactive waste management at SSM in kSEK - 1 SEK is about 0.1 Euro

The support to a doctoral candidate position within nuclear chemistry at Chalmers University of Technology continues with the purpose to strengthen the national competence about how nuclear fuel reacts in the disposal facility environment. Within the research area of rock mechanical modeling, SSM gives support to the U.S. Lawrence Berkeley National Laboratory. In 2010 two long term research projects were initiated at Stockholm University in the areas of glaciation and radioecology-environmental risk assessment and one research project was initiated at the University of Gothenburg in the area of buffer erosion-colloid chemistry.

During 2010 the SSM continued its preparation for assessing the SKB licence application for a deep geological disposal facility for spent nuclear fuel which was submitted to the authority in March 2011. Issues for assessment of long-term safety have been assembled and a preliminary assessment plan for Clab and the planned encapsulation facility were established. During 2010 SSM, through a number of expert meetings, followed the development within the different relevant technical

areas. To exchange experience and information in connection with preparations, formal assessment, and supervision of the disposal facility for spent nuclear fuel, a co-operation with the Finnish Nuclear and Radiation Safety Authority, STUK, started.

E.3.3 Independence of the regulatory function

The de jure and de facto independence from political pressure and promotional interests are well provided for in Sweden. The laws governing SSM concentrate solely on nuclear safety, radiation protection (also security, physical protection, and non-proliferation, but outside of the scope addressed in this convention). SSM reports to the Ministry of Environment, which is not involved in the promotion or utilization of nuclear energy. These issues are handled by the Ministry of Enterprise, Energy and Communications. An individual minister cannot interfere with the decision making of a governmental agency according to fundamental Swedish law. This is a matter for the Government, in plenum.

E.3.5 Conclusion

Sweden complies with the obligations of Article 20.

This page is intentionally left blank

F.1 Article 21: RESPONSIBILITY OF THE LICENCE HOLDER

1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.
2. If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.

F.1.1 Regulatory requirements

F.1.1.1 The prime responsibility

According to the Act on Nuclear Activities a party that holds a licence for nuclear activities shall be responsible for ensuring that all the necessary measures are taken for:

- maintaining safety, taking into account the nature of the operation and the circumstances in which it is conducted,
- safe management and disposal of nuclear waste generated by the operation or nuclear material derived from the operation that is not reused, and
- safe decommissioning and dismantling of facilities in which the operation shall be discontinued until such date that all operations at the facilities have ceased and all nuclear material and nuclear waste have been placed in a disposal facility that has been sealed permanently.

According to the Radiation Protection Act, parties conducting activities involving radiation shall, while taking into account the nature of the activity and the conditions under which it is conducted

- take the measures and precautions necessary to prevent or counteract injury to people and animals and damage to the environment,
- supervise and maintain the radiation protection at the site, on the premises and in other areas where radiation occurs, and
- properly maintain technical devices and monitoring and radiation protection equipment used in the activity.

In the Governmental Bills to the acts it is also underlined that the licensee shall not only take measures to maintain safety and radiation protection but also measures to improve these protective measures where this is justified.

The SSM Regulations on Safety in Nuclear Facilities (SSMFS 2008:1) specify the responsibility of the licensee through a number of functional requirements on safety management, design and construction, safety analysis and review, operations, nuclear materials-/waste management and documentation /archiving. In addition it is clearly pointed out in these regulations that safety shall be monitored and followed up by the licensee on a routine basis, deviations identified and corrected so

that safety is maintained and further developed according to valid objectives and strategies.

The required continuously preventive safety work includes reassessments, analysis of events in the own and other facilities, analysis of relevant new safety standards and practices and research results. Any reasonable measure useful for safety shall be taken as a result of this proactive and continuous safety work and be documented in a safety programme that shall be updated annually.

The basic safety documentation (SAR including Operational Limits and Conditions, plans for emergency response and physical protection) must be formally approved by SSM. Plant and organizational modifications and changes in the safety documentation are to be notified and SSM can, if needed, impose additional conditions and requirements. All other issues are handled under the licensee self-inspection. SSM examines how this liability is managed.

According to the SSM Regulations on Basic Provisions for the Protection of Workers and the Public in Connection with Work with Ionizing Radiation (SSMFS 2008:51) anyone who conducts activities with ionizing radiation shall ensure that the practice is justified by which is meant that the use of radiation gives a benefit that exceeds the estimated health detriment caused by the radiation. The radiation protection measures shall be optimized and by which is meant that human exposures are as low as reasonably achievable, social and economic factors taken into account and no dose limit in these regulations is exceeded. These basic radiation protection principles also apply for waste management and disposal as regulated in SSM Regulations on the Protection of Human Health and the Environment in connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste (SSMFS 2008:37).

The optimization and use of the best available technique also apply to discharges to the environment during the normal operation of nuclear facilities. This is regulated in Regulations on Protection of Human Health and the Environment in connection with Discharges of Radioactive Substances from certain Nuclear Facilities (SSMFS 2008:23)

The SSM shall ensure that regulations and used procedures are cost effective and useful for individuals as well as companies. They must be written and designed so that the regulatory body does not take over the prime responsibility for safety and radiation protection.

The supervision that SSM carries out shall control that the licensees operates the activity in a safe way and with the maintenance of radiation protection.

F.1.1.2 The ultimate responsibility

The State has an overall responsibility for activities regulated in the Act on Nuclear Activities. However, this ultimate responsibility has not explicitly expressed in the legislation, but through Government statements. Therefore, clarification of the State responsibility has therefore been considered necessary in the legislation.

F.1.2 Measures taken by the license holder

SKB is the licensee for Clab, situated at the Oskarshamn site, and SFR, situated at the Forsmark site. The operation of Clab and SFR was previously contracted out to OKG and FKA respectively. SKB took over the operation of Clab in January 2007

and the operation of SFR in July 2009. The takeover is a natural step in SKB´s development, where the emphasis in the activities is gradually shifting from research and development to operation of nuclear facilities. The experience gained from the construction and operation of Clab and SFR is important in the planning of the future facilities.

Spent fuel and waste management at the nuclear power plants, such as waste packaging, waste minimization and interim storage at the sites are the responsibility of the nuclear power companies. Inspection of on-site management of radioactive waste is carried out by SSM inspectors. The production and storage of radioactive waste at the plants is reported annually to SSM and to the Swedish Nuclear Fuel and Waste Management Company (SKB). The Nuclear power companies have given SKB responsibility for managing the nuclear waste from the time the waste leaves the nuclear power plants. SKB therefore closely follow the predisposal management activities performed at the nuclear power plants sites.

F.1.3 Regulatory control

SSM takes a number of regulatory actions to make sure that licensees give adequate priority to safety and radiation protection. Examples are the following:

- Inspections, major and minor inspections targeted to assess safety and radiation protection issues. The inspections, as well as other types of regulatory supervision, can have a wide scope. Examples are inspections of the licensee safety programmes, management of organisational changes, management of safety review, management and assessment of incidents (conservative decision making) as well as in-depth focus on specific issues and control.
- Reviews of different documents, including safety analysis reports, instructions, licence applications etc.
- Investigations in connections with events (SSM has a special methodology, RASK, for rapid response inspections) and assessments of event reports.
- The integrated safety assessments (se section E.2.2.3) provide an updated comprehensive regulatory assessment of the safety of the facility. A management meeting follows each SSM integrated safety assessment.
- Regular top management meetings with the licensees. The Director General of SSM and the department directors meet with the management group of each nuclear power plant and other major facilities at least once a year to discuss current issues and safety priorities. There are also annual meetings with the corporate executives of the utilities.
- SSM follows the licensees work with safety culture issues mainly through minor inspections. The role of SSM in this context is to ensure that the licensees have proactive safety management. SSM expects the licensees to create and maintain a strong safety culture. One important part of this, of great interest for SSM, is that the licensees react in a timely manner to indications of deficiencies in their safety culture. If such deficiencies are not corrected, the ability of the operating organisation to handle difficult situations and maintain safety will deteriorate.

F.1.4 Conclusion

Sweden complies with the obligations of Article 21.

F.2 Article 22: HUMAN AND FINANCIAL RESOURCES

Each Contracting Party shall take the appropriate steps to ensure that:
(i) qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;
(ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning;
(iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

F.2.1 Regulatory requirements

F.2.1.1 Qualified staff during the operation lifetime

The general safety regulations concerning safety in nuclear facilities (SSMFS 2008:1) are specific about the staffing of the nuclear facilities. Long term planning is required of the licensees in order to ensure that they have enough staff with sufficient competence for all safety-related tasks. A systematic approach should be used for the definition of the different competences needed, planning and evaluation of all safety related training. It is also a requirement that there is a balance between the use of in-house personnel and contractors for safety related tasks. The competence necessary for ordering, managing and evaluation of the results of contracted work should always exist within the organisation of a nuclear installation.

The regulations also contain provisions that the staff must be fit for their duties. This implies medical requirements and tests for drugs, etc. Such provisions have not been issued previously. How the licensee manages the fitness for duty issues has, however, been followed through inspections.

F.2.1.2 Adequate human and financial resources

During operation and decommissioning
It is clear from the Swedish Act on Nuclear Activities that in order to obtain a licence, economical resources must be committed in order to manage the safety obligations mentioned in chapter 10 of the Act. Every presumptive licensee must be assessed in this respect during the licensing procedure.

Provision for financial resources during decommissioning is provided by means of investments in government controlled funds. Licensees of nuclear facilities must pay a fee to the Nuclear Waste Fund, according to the Act (2006:647) on

Financial Measures for the Management of Residual Products from Nuclear Activities as described in section E.2.2.5. This is to ensure the financing of decommissioning, handling and disposal of spent fuel and nuclear waste, including the research needed for these activities.

The disposal facility for radioactive operational waste (SFR) has been paid for directly by the nuclear power utilities and not by the Fund. Operational waste is not covered by the Act on Financial Measures for the Management of Residual Products from Nuclear Activities but is instead paid for by the nuclear power utilities at the time the waste is produced. However, disposal in SFR of operational waste from Clab is paid for through the Nuclear Waste Fund, since all of Clab's operations are financed by this Fund.

Provisions for institutional control and monitoring after closure
As described in chapter F.6.1.1 the holder of a licence for nuclear activities shall be responsible for ensuring that all measures are taken that are needed for the safe decommissioning and dismantling of plants in which nuclear activities are no longer to be conducted. Institutional control and monitoring is not foreseen in the Swedish management system for spent fuel and radioactive waste. It follows that a licensee may be exempted from their responsibilities when decommissioning and dismantling has taken place and financial provisions for institutional control and monitoring after closure are not required.

The State has an overall responsibility for activities regulated in the Act (1984:3) on Nuclear Activities as described in section F.1.1.2. It follows that if the need for institutional control and monitoring were to arise in the future, the State would be responsible for the arrangements and costs.

F.2.2 Measures taken by the license holders

F.2.2.1 Qualified staff during the operation lifetime

In the near future new facilities will be built and put into operation. Therefore SKB needs to ensure and broaden the competence concerning the operation of nuclear facilities. An important step in that direction was taken when SKB took over the operation of Clab in January 2007 and the operation of SFR in July 2009, which was previously contracted out to OKG and FKA, respectively (see also sub-section F.2.1.2).

F.2.2.1 Adequate human and financial resources

As described in the introduction, the nuclear power utilities have formed a jointly owned company, the Swedish Nuclear Fuel and Waste Management Company (SKB), to fulfill their obligations regarding nuclear waste management. SKB is assigned by the nuclear utilities to make their cost estimates that form the basis for calculating the nuclear waste fee that the licensees of nuclear power plants must pay to the Nuclear Waste Fund.

The NPP licensees also make two forms of guarantees available to the government in the event that the Nuclear Waste Fund should prove to be inadequate. The two types of guarantees serve different purposes (see section E.2.2.5).

F.2.3 Regulatory control

Qualified staff during operation
The compliance with the requirements on competence assurance was inspected a few years ago at all nuclear power plants. The regulatory authority continued to follow up on these inspections and has now concluded that the required systematic approaches are in place at all nuclear power plants to assure long term staffing and competence of operations staff.

At the time, both Clab and SFR benefited from these improvements as the management systems for operation those facilities were fully integrated with the management systems for the operation of the nuclear power plants at OKG and FKA respectively.

Before SKB was allowed to take over operation of Clab in January 2007, the regulatory authority reviewed and approved the organisational change. The implementation of the operation organisation for Clab was a considerable change to the SKB organisation. A key issue in this respect was the establishment of a safety review function, as required by the general regulations (SSMFS 2008:1). Beside the new area of responsibility within the SKB organisation the number of SKB staff increased from about 220 to 300 in total.

Adequate financial resources
The regulatory authority assigned by the Government, SSM, reviews the licensees cost estimates according to the Act on Financial Measures for the Management of Residual Products from Nuclear Activities. Furthermore, SSM reviews the size of the guarantee that the licensees must make available to ensure that the financing system will be able to meet future needs. After its review of the nuclear power utilities' cost estimates, SSM submits a proposal for the size of the fees, and the size of the guarantees required, to the Government. Based on this proposal, the Government sets the fees and guarantees. For licensees of nuclear facilities other than nuclear power reactors, SSM sets the fees and guarantees for the following three years after reviewing cost estimates submitted by the licensee.

F.2.4 Conclusion
Sweden complies with the obligations of Article 22.

F.3 Article 23: QUALITY ASSURANCE

Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

F.3.1 Regulatory requirements

The general safety regulations SSMFS 2008:1 (chapter 2, 8 §) require that nuclear activities: design and construction, operation and decommissioning, shall be managed, controlled, assessed and developed through a management system so designed that requirements on safety will are met. The management system including the needed routines and procedures shall be kept up to date and be documented. This view on quality and safety to be integrated with other business concerns into an integrated management system is in line with the recently issued IAEA Safety Standards Series No. GS-R-3, The Management System for Facilities and Activities.

It is further required in regulations that the application of the management system, its efficiency and effectiveness, shall be systematically and periodically audited by a function having an independent position in relation to the activities being audited. An established audit programme shall exist at the plant.

In the general recommendations to the regulations it is made clear that the management system should cover all nuclear activities at the plant. Furthermore, it should be clear from the management system how to audit contractors and vendors, and how to keep results from these audits up to date.

The internal audit function should have a sufficiently strong and independent position in the organisation and report to the highest manager of the plant. The audits should have continuity and auditors have a good knowledge about activities being audited.

Audit intervals should take into account the importance for safety of the different activities and special needs that can arise. Normally all audit areas should be covered every four years as a minimum.

The auditing activity itself and the management function of the plant should also periodically be audited.

F.3.2 Measures taken by the license holder

Quality programmes – NPP

In Sweden the general description of the quality and management system is normally regarded as the plant's most important document, as it gives an overview of the requirements and the way in which the organization is supposed to work in order to meet these demands. The documents are to be kept available for everyone in the plant organization, and also for others who are affected by the information in the documents, for instance contractors, consultants and the regulatory autho-

rities. All documents in the quality and management system are under controlled revision, regularly or when needed, in order to reflect the actual situation at the plant at all times.

Development of quality assurance programmes at the Swedish NPPs began during the late 1970's. These programmes have since been developed continuously over the years, and have, of course, been affected by regulations and expectations from the regulatory body and business associates. In the beginning, the quality manuals of the NPPs were limited to descriptions of routines in a number of functional areas, but they lacked clear statements of the objectives and requirements. During the 1990s there was considerable development of the concept, and the quality assurance programmes of the Swedish NPPs are today integrated in the total management system of every plant.

The main principles are the same for the quality and management systems of the Swedish NPPs, with documents on three levels. The first level (top-level) documents are issued by the plant director. Included in these are typically a vision to strive after, a business idea which outlines the mission of the facility, objectives for different areas and strategies to accomplish the objectives. Objectives typically exist for:

- nuclear safety,
- occupational safety,
- economic results,
- confidence from society,
- environmental impact, and
- personnel responsibility

A comprehensive description of the organization with responsibilities for functions and processes, division of responsibility and management principles are also included in the top-level documents. Furthermore, there are policies, conditions and directives for the main activity processes at the plant. In the conditions all the legal requirements are included, as well as the plant owners' requirements and additions. Finally the top-level documents include directives to all departments and staff units at the power plant.

The second level documents of the management system contain commitments from the responsible managers on how to work with the tasks delegated by the plant director in the top-level documents. These replies are given as objectives, directives, process descriptions and instructions for the different areas of responsibility.

The third level documents include instructions for specific activities and tasks included in the different areas of responsibility as defined by the second level documents.

In addition to the three levels of documents, there can also be various types of administrative handbooks.

The purpose of the quality and management system is to achieve a unified and consistent control system for all plant activities based on clear policies and measurable objectives. There should be complete traceability from policy to work instruction.

The standard ISO 9001:2000 for quality management systems, lead to more emphasis on processes and attempts to implement process-orientation in the organisa-

tion and daily work.

Quality programmes – SKB
The management system of SKB consists of a number of steering documents divided on overall company level (blue part) and an operational level (beige part). Below is an explanation of the hierarchy and definitions of policy, guideline, routine and instruction.

Quality system implementation and quality audit programmes
Every Swedish NPP and SKB has developed a quality audit programme, which is used to monitor how well the quality system is implemented and applied in the organization on different levels, as well as the efficiency of the system to ensure quality and safety. Being responsible for the long-term safety of SFR, SKB also reviews all NPP companies with regard to fulfillment of regulatory requirements concerning waste generation and conditioning.

Quality audits of suppliers
According to the requirements on quality assurance in the general regulations SSMFS 2008:1, all purchases of goods and services which might have an effect, directly or indirectly, on the protection and safety of the environment or personnel, shall be made from suppliers that through quality audits, or in other ways, have shown that they can comply with quality requirements.

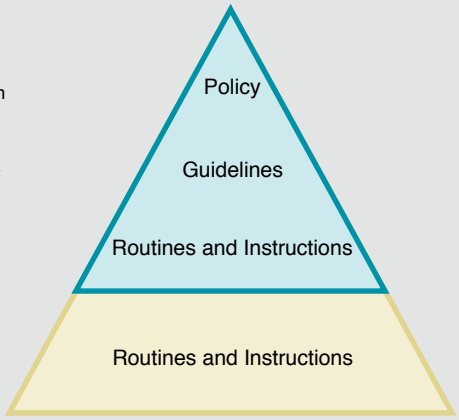
SKB Management System

Policy = SKB:s policy is the top steering document in the management system and explains the ambitions and the overall focus for the whole organisation.

Guideline = Steering document with explanations and details on SKB:s policy and overall frames for the work within specific areas.

Routine = Steering document including requirements, responsibility, authorithy and explanations on how to perform tasks.

Instruction = Steering document which in detail explains how to perform certain task. An instruction is always coupled to a routine.



The ambition of the licensees is not limited to these demands, but also includes suppliers of goods and services, where malfunctioning might cause considerable consequences for the operation. A review of a supplier includes not only a quality audit, but also a technical and commercial evaluation of the equipment or services offered. Since 1998 a review of the supplier's environmental management system is included in the review. These aspects will, however, not be covered in this report. The purpose of a quality audit of a potential supplier is not only to evaluate whether the supplier has implemented and uses a documented quality system, but also to evaluate the supplier's capability of providing the correct and expected quality. Quality audits are typically performed by teams of 1-4 auditors. The audit team shall be led by a person with documented knowledge and experience in the QA

area and with the quality norms. The team leader shall have experience from participation in several quality audits. The team shall comprise one or more persons with competence or experience from the product or service to be reviewed. Thus, there is no formal licensing of audit team leaders and team members for Swedish nuclear facilities.

A quality audit results in a report, which must be accepted by the company reviewed, before being presented to the purchasing organization. If deficiencies are revealed during the audit, the organization under review is requested to describe what measures will be taken to correct the deficiencies, in order to be accepted as a supplier of products or services to the organization. In certain cases a follow-up visit of the audited company is required to verify that the company has taken the actions.

Approved quality audits accomplished by any of the other Swedish NPPs are normally considered comparable with a plant's own quality audits and, consequently, audit duplications of a given supplier can be avoided. Simplified quality audits or evaluation of previous experience of a supplier are sometimes acceptable, when purchasing goods and services dedicated for use in the lower quality classes.

F.3.3 Regulatory control

SSM's own quality system has included guidance for SSM-staff when reviewing the licensees' quality systems. Usually the quality system itself has not been the only target for SSM's review and inspections. Appropriate aspects of the application of quality assurance are included in all SSM regulatory inspections. Thus during inspections, routines and instructions are studied, as well as how they are enforced in practice in order to control safety-related activities.

SSM has also made assessments of quality assurance processes when reviewing large modification plans, for example the recent extension of Clab. The licensees' plans for quality audits and the reports from the audits that have been performed have also been subject to review by SSM.

In general SSM has been satisfied with the implementation of quality assurance. The development of the integrated approach to quality and management systems has taken several years and considerable effort. In some cases implementation has not been well prepared, and has been slowed down due to insufficient staff resources, or lack of support from all organizational levels. Organizational changes have also affected the implementation work, and made revisions necessary.

The regulatory experience shows the necessity of having a living quality audit programme at the plants, and using the audits to develop quality and safety. This means that the audits should not only investigate compliance with the documented routines, but also the suitability and the efficiency of the routines in line with the concept of a learning organization.

F.3.4 Conclusion

Sweden complies with the obligations of Article 23.

F.4 Article 24: OPERATIONAL RADIATION PROTECTION

1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactiv waste management facility:
   (i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;
   (ii) no individual shall be exposed, in normal situations, to radia tion doses which exceed national prescriptions for dose limi tation which have due regard to internationally endorsed standards on radiation protection; and
   (iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.
2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:
   (i) to keep exposure to radiation as low as reasonably achiev able, economic and social factors being taken into account; and
   (ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internation ally endorsed standards on radiation protection.
3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioac- tive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

F.4.1 Regulatory requirements

In order to regulate, and create a basis for effective supervision of, radiation protection at nuclear facilities, including those for management of spent nuclear fuel and radioactive waste, basic radiation protection requirements are laid down in a number of SSM regulations.

F.4.1.1 Regulatory requirements on occupational radiation protection

The Swedish occupational radiation protection requirements aimed at the nuclear facilities are similar to those of other EU Member States since they follow the bin- ding requirements of the Council Directive 96/29/Euratom of 13 May 1996, laying down basic safety standards for the health protection of the general public and workers against the dangers of ionising radiation. The principal provisions as re-

gards occupational radiation protection are found in the SSM regulations SSMFS 2008:24, SSMFS 2008:26, SSMFS 2008:51, and SSMFS 2008:52, accounted for in section E.2.2.3. The most important provisions in the context of the Joint Convention are briefly summarized below.

General Requirements and dose limits
Anyone who conducts an activity with ionising radiation shall ensure:
1. Justification: The activity is justified by which means that the use of radiation gives a benefit to individuals and to the society that exceeds the estimated health detriment caused by radiation.
2. Optimisation: The radiation protection measures are optimised by which is meant that exposures, and the probability and magnitude of potential exposures, are as low as reasonably achievable, economic and societal factors taken into account.
3. Dose limitation: The activity is carried out in such a way that no radiation dose limits are exceeded.

Optimisation
Anyone who conducts a practice with ionising radiation shall ensure that the radiation protection measures are optimised, and that no radiation dose limit is exceeded. The licensee shall ensure that documented goals and actions for the optimisation work are established and that the necessary resources are available in order to perform the actions and work towards the established goals.

Dose limits for workers
The limit for a worker regarding effective dose is 50 mSv in a calendar year, with the additional constraint that the integrated effective dose over five consecutive years must not exceed 100 mSv. The equivalent dose limit to the lens of the eye and to skin, hands and feet is 150 mSv and 500 mSv in a year, respectively. Lower limits apply for apprentices and special rights for rearrangements at work apply to breast-feeding and pregnant woman. Additional requirements ensure that the dose to a foetus does not exceed 1 mSv for the remaining period of a pregnancy. Data on intakes an individual radia-tion doses are kept in the national dose register. Dose records are saved until a person has reached 75 years, and at least until 30 years after work with ionising radiation has stopped.

Medical examination
A worker must each year arrange for a new doctor's certificate as proof of that he/she is fit for service. At least every third year this must be based on a full medical examination by a doctor.

Supervised and controlled areas
Zoning of the workplace and a division into supervised and controlled areas is required. Areas shall be marked and radiological information given (dose rates, sources, contamination levels, entrance restrictions, etc.).

If there is a risk for spread of contamination or the annual effective dose could exceed six mSv, the workplace shall be classified as a controlled area. The access is then more restricted, protective clothing and personal protection equipment could be mandatory, specific information/education is required, and a personal do-

simeter shall be worn. Within a controlled area, premises shall be specially marked and admittance restricted (locked with special keys) if the risk of receiving an annual effective dose of more than 50 mSv is non-negligible.

Visitors
Visitors are allowed if guided by designated persons and a strict, pre-arranged visit plan is followed. No high-dose areas may be visited.

Information and education
All personnel, permanent staff and contractors, shall be informed about radiation risks and have proper education prior to work within a controlled area. The training shall be adjusted to the scope and type of the work to be performed and to the existing radiological working environment.

Site-specific instructions, radiation protection expert
The licence holder shall ensure that site specific instructions for radiation protection are established. The licensee shall also appoint a radiation protection expert. This person shall be approved by SSM and have sufficient competence in matters related to radiation protection to be able to promote active radiation protection work and to check on the implementation of the radiation protection legislation.

Instruments and equipment
All instruments used for radiation protection and the control of radiation doses shall be calibrated and undergo regular functional checks.

Policy in the event of fuel failures
A documented policy with a strategy for avoiding fuel failures and how to manage fuel failures if they occur is mandatory. The aim is to minimize the negative radiological impact on radiation doses to workers and the public.

Reporting
Annual reports describing the radiation protection work, the progress and evaluation of the optimisation work, and experience from the outages are required. In the case of an accident or events that led or could have led to contamination spread or high doses, rapid communication to the regulatory body is required. Various other reports are required. The radiation protection expert keeps track of the timely and accurate reporting.

F.4.1.2 Regulatory requirements on environmental radiation protection

The Swedish Radiation Safety Authority's regulations (SSMFS 2008:23) concerning the protection of human health and the environment from discharges of radioactive substances from certain nuclear facilities apply to nuclear facilities under normal operations as described in section E.2.2.3. The most important provisions are described in the following.

Public dose limits, dose constraints and critical group
The effective dose limit for members of the public is 1 mSv per year. A dose constraint for the discharges of radioactive substances to water and air (authorized

releases) is set to 0.1 mSv per year and site. The dose constraint is subject to comparison with the calculated dose to the most exposed individual (critical group). The dose models used are approved by the SSM.

The 0.1 mSv dose constraint is compared with the sum of a) the effective dose from the annual external exposure, and b) the committed effective dose resulting from a yearly discharge. A 50-year integration time is used for the committed effective dose. If the calculated sum dose exceeds 0.01 mSv per year, realistic calculations of the individual radiation doses, using measured dispersion data, food habits etc., shall be made for the most affected area.

Discharge limits
The discharge limit is achieved through the restriction of the radiation dose to the critical group. There are no legal nuclide-specific discharge limits in Sweden.

Optimisation and Best Available Technology
Limitation of releases shall be based on optimisation of radiation protection and with the use of the Best Available Technology (BAT).

Release monitoring
The release of radioactive substances shall be measured. All non-monitored releases shall be investigated and an upper boundary for possible undetectable leakage to air and water from each facility shall be set.

Releases via the main stacks of nuclear power reactors shall be controlled by continuous nuclide-specific measurements of volatile radioactive substances such as noble gases, continuous collection of samples of iodine and particle-bound radioactive substances, as well as measurements of carbon-14 and tritium.

Discharges of radionuclides to water shall be controlled through measurements of representative samples from each release pathway. The analyses shall cover nuclide-specific measurements of gamma and alpha-emitting radioactive substances as well as, where relevant, strontium-90 and tritium.

Controls and testing
The function and efficiency of measurement equipment and release limiting systems shall be checked periodically and whenever there are any indications of malfunctions.

Environmental monitoring
Environmental monitoring in the areas surrounding nuclear facilities shall be performed according to monitoring programmes determined by SSM. The programmes specify the type and sampling frequency, sample treatment, radio-nuclides to consider, reporting etc. The Swedish Agency for Marine and Water Management performs sampling at and outside the facilities. Samples are analysed by the nuclear facilities or by external laboratories which have adequate quality assurance systems. To verify compliance, SSM performs inspections and takes random subsamples for control measurements at SSM or at other independent laboratories.

Reporting
The nuclear reactor licensees report annually to SSM adopted or planned measures to limit radioactive releases with the aim of achieving their specified target values.

If established reference values are exceeded, the planned measures to achieve the reference values shall be reported.

Releases of radioactive substances to the air and water as well as results from environmental monitoring shall be reported twice a year to SSM. Events that lead to an increase in releases of radioactive substances from a nuclear facility shall be reported to SSM as soon as possible, together with a description of the actions taken to reduce the releases.

F.4.2 Radiation impact of spent nuclear fuel or radioactive waste management facilities

F.4.2.1 Occupational radiation doses

In general both individual and collective doses from radioactive waste handling at nuclear power plants are low compared to doses from normal operation, and maintenance and service work performed at outages. Nevertheless it is important that the working methods are carefully planned and in compliance with the existing regulatory requirements (see Section F.4.1.1), to make sure that occupational radiation protection is optimized.

In this section, examples of occupational doses received at spent fuel and radioactive waste management facilities are presented. Personnel that work with radioactive waste at the nuclear power plants are exposed to annual doses in the order of a few mSv. The annual collective doses at the nuclear power plants to this category of workers are normally in the order of 10-20 mmanSv.

At the central interim storage facility for spent nuclear fuel (Clab), doses are obtained from the normal operation with receiving, unloading and cleaning the transport containers. In addition, maintenance and service of Clab's internal lift and handling equipment, and the water cleaning system give radiation doses. The work doses to the personnel at Clab reported between 1998 and 2010 are shown in figure F1.

No open radiation sources are handled at the disposal facility for low and intermediate level waste (SFR) and all radioactive waste is conditioned. Thus, the doses to the personnel originate only from external radiation. Contamination of transport casks and waste packages has never occurred to the extent that any airborne radioactivity has been measured or reported. There are some variations depending upon whether waste packages have been covered with cement during the year or not. The yearly doses to the personnel at SFR are very low, so low that they are barely measurable.

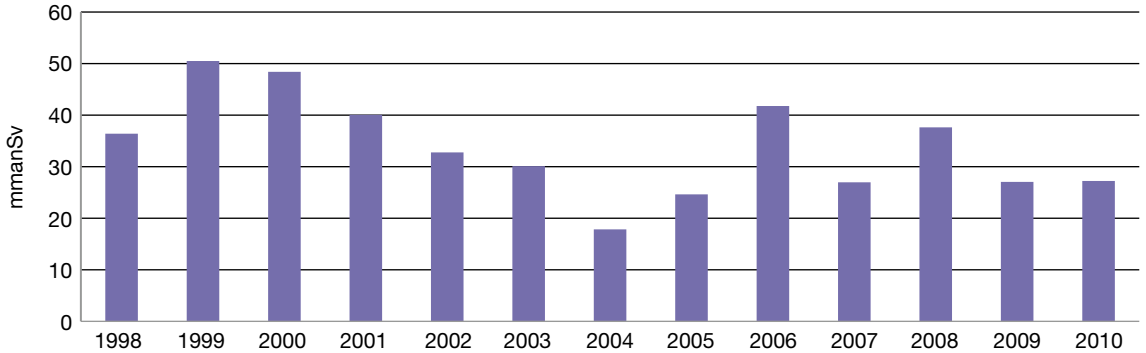


Figure F1: Work doses to the personnel at Clab 1998-2010

Studsvik operates several facilities for treatment of radioactive waste. For 2010 Studsvik reported an annual collective dose of 0.51 manSv and an average individual effective dose of 3.1 mSv. For staff that works with waste management at Westinghouse Electric Sweden AB fuel factory annual individual doses are below 1 mSv.

F.4.2.2 Radiation doses from releases of radioactive substances

Figure F2 displays the estimated effective dose (in microsievert) to the representative person ("critical group") from the releases of radioactive substances at the major Swedish nuclear facilities for the years 2005-2010. The resulting estimated effective doses are less than 1 % of the stipulated dose constraint of 0.1 mSv at all the Swedish sites.

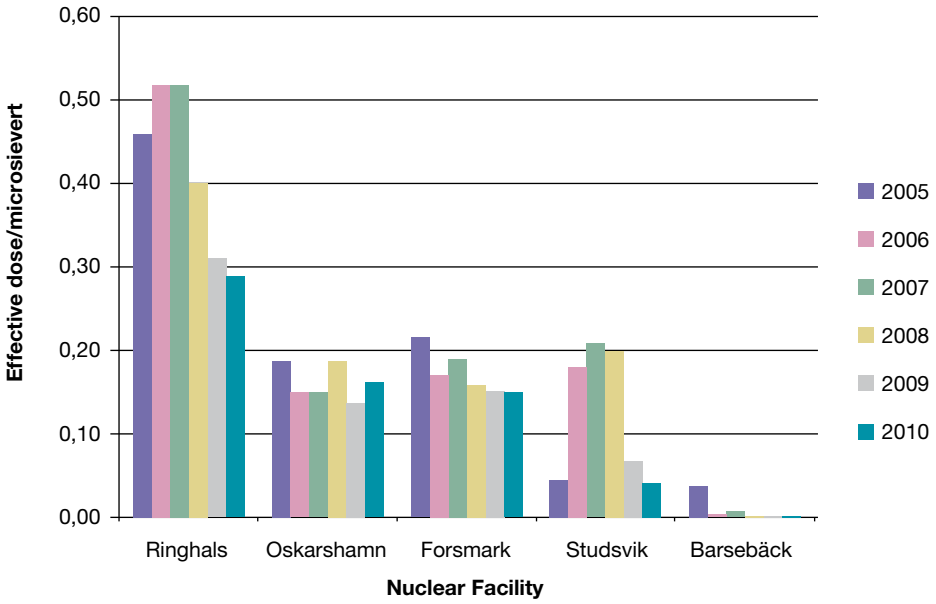


Figure F2: Estimated radiation doses in microsievert (µSv) to the "representative person" from releases of radioactive substances at Swedish nuclear facilities in the period 2005-2010

Through the installation of new abatement systems and successive clean-up of primary systems the releases at the power plants have generally decreased during the last decade. The somewhat larger releases at Ringhals are due to the contribution from carbon-14 from the PWR reactors.

From the available release data it is not possible to single out releases from the radioactive waste management at the NPPs. The releases of radioactive substances from Clab, SFR and Ranstad Mineral are very small. From the closed and partially dismantled Ågesta reactor (PHWR) small amounts of tritium is released through the drainage of the rock chamber where the shutdown reactor is situated.

F.4.3 Regulatory control

See section E.2.2.3 for SSM control and inspections

F.4.4 Conclusion

Sweden complies with the obligations of Article 24.

F.5 Article 25: EMERGENCY PREPAREDNESS

1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.
2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

Summary of developments since the last national report

- The realization of a single authority, SSM, led to the merger of the emergency preparedness responsibilities of the two former authorities. A new crisis organisation was developed at SSM and regulatory supervision of the emergency planning at the facilities was strengthened. SSM's regulations on emergency planning and preparedness entered into force on July 1, 2008.
- The Swedish Emergency Management Agency (KBM) and the Swedish Rescue Services Agency (SRV) were merged into a new agency, the Swedish Civil Contingencies Agency (MSB) in 2009. The task of the MSB is to enhance and support the societal capacities for preparedness for and prevention of emergencies and crises.
- A national web-based information system is used for information exchange during all types of crises. The Swedish gamma monitoring system was replaced and modernized during 2008 - 2010.
- At all NPP's the organisation has been strengthened to ensure that key persons are available at an early stage during an unusual event. A third alarm level has been introduced to be used when extra support is needed during events of a lower class than those classified as increased preparedness.
- As a follow-up to the TEPCO Fukushima Dai-ichi NPP nuclear accident, SSM, on May 25 2011, decided that the NPP licensees and SKB shall redo the safety assessments for the NPPs and for the interim storage for spent nuclear fuel at Clab at Oskarshamn.

F.5.1 Regulatory requirements

The emergency plans for the three operating nuclear power plants and the industry facilities at Studsvik include all the installations for spent fuel and radioactive waste management at these facilities. SKB has an emergency plan for the Clab interim storage for spent nuclear fuel. There is no formal requirement for an emergency plan at SFR; however a rescue organisation exists nevertheless. Westinghouse Sweden Electric AB operates the fuel fabrication facility in Västerås which also has an emergency plan.

Requirements on on-site emergency activities and plans for the nuclear facilities are included in several legally binding documents:

- The Civil Protection Act (SFS 2003:778) regarding protection against accidents with serious potential consequences for human health and the environment,
- The Civil Protection Ordinance (SFS 2003:789) regarding protection against accidents with serious potential consequences for human health and the environment,
- SSM regulations (SSMFS 2008:1) concerning safety in nuclear facilities, and
- SSM regulations (SSMFS 2008:15) concerning emergency preparedness at certain nuclear facilities.

The overarching objective of the Civil Protection Act (2003:778) is the civil protection for the whole country – with consideration given to local conditions – for life, health, property and the environment against all types of incident, accident, emergency, crisis and disaster. The Act requires preventive measures and emergency preparedness to be arranged by the owner or operator of a facility with dangerous activities. The Act further defines the responsibilities for the individual, the local communities, and the state in cases of serious accidents, including radiological accidents. The Act contains provisions as to how the community rescue services shall be organized and operated and also stipulates that a rescue commander with a specified competence, with far-reaching authority, is to be engaged for all rescue operations. According to the Act, the County Administrative Board is responsible for the rescue operations in cases where the public needs protection from a radioactive release from a nuclear installation or in cases where such release seems imminent.

The Civil Protection Ordinance (2003:779) contains general provisions concerning emergency planning and is more specific about reporting obligations, information to the public, and the responsibility of the county authority for planning and implementing public protective measures, contents of the off-site emergency plan, competence requirements on rescue managers and inner emergency planning and monitoring zones around the major nuclear facilities. The County Administrative Board is obliged to make a radiological emergency response plan. The Swedish Civil Contingencies Agency is responsible, at the national level, for the coordination and supervision of the preparedness for the rescue services response to radioactive release. SSM decides on necessary measures for and supervises the nuclear installations.

The SSM-regulations SSMFS 2008:1 require the licensee, in case of emergencies, to take prompt actions in order to:

- classify the event according to the alarm criteria,
- alert the facility's emergency preparedness organisation,
- assess the risk for and size of possible releases and time related aspects,
- return the facility to a safe and stable state, and
- inform the responsible authorities.

The actions shall be documented in an emergency preparedness plan which is subject to safety review by the licensee and must be approved by SSM. The plan shall be kept up to date and validated through regular exercises. SSM shall be notified

of changes in the plan. The licensee has to assign staff, provide suitable facilities, technical systems, tools and protective equipment needed to solve the emergency preparedness tasks. The emergency planning should include all design basis accidents, as well as beyond design basis events, including severe events, and combinations of events, such as fire or sabotage in connection with a radiological accident.

The SSM regulations SSMFS 2008:15 on emergency planning and preparedness have a radiation protection perspective. They are mainly based on the IAEA Safety Standards GS-R-2: Preparedness and Response for a Nuclear or Radiological Emergency and include requirements on:

- Emergency planning including alarm criteria and alarming
- Emergency rooms/premises/facilities and assembly places
- Training and exercises
- Iodine prophylaxis
- Personal protective equipment
- Evacuation plan
- Contacts with SSM
- Radiation monitoring
- Emergency ventilation
- Collection of meteorological data

Depending on the radiological hazard potential at the facility, the requirements regarding radiation monitoring, emergency ventilation, and collection of meteorological data differ.

F.5.2 National monitoring and measuring

The Crisis Management Co-ordination Secretariat was established in March 2008 within the Government Offices of Sweden to strengthen the crisis management and communication capability. The responsibilities include policy intelligence and situation reporting, crisis management and crisis communications, analysis, and being a central contact point at the Government Offices.

Nearly all accidents and crisis situations are handled by appointed central or regional authorities who, with their allocated resources, manage these situations. However, if a national crisis with the potential to affect many citizens with (coupled) large, cross-sector negative economic, environmental or other detrimental societal effects occurs, it will require decisions and actions by the Government. The Secretariat gathers information, assesses the situation, and recommends Government actions. The Prime Minister's Office, with the support of the Crisis Management Secretariat, shall ensure that the necessary cooperation within the Government Offices and with the relevant authorities is rapidly established.

On January 1, 2009 the Swedish Civil Contingencies Agency (MSB) was formed, merging three earlier central authorities with emergency preparedness and civil defence responsibilities. MSB co-ordinates emergency preparedness funding and work, and oversees the planning of the regional County Administrative Boards. MSB, together with other concerned authorities, started a long-term work to strengthen the national nuclear emergency preparedness planning and response work. The focus is, as earlier suggested by the Swedish National Audit Office, on ensuring needed economical means, improving the quality of risk and threat analysis, improving supervision of necessary training and education, further deve-

loping procedures for follow-up and experience feed-back, and ensuring due consideration of long-term and post-accident effects in the emergency preparedness planning and work.

SSM is taking part in the national planning and development process. Some actual results of these efforts are an enhanced national emergency response centre and a countrywide measurement, sampling and analysis expert organisation for radiological and nuclear accidents and events.

The two national alarm levels for nuclear emergencies: 1) Increased preparedness and 2) General emergency were complemented by a third, lower level alarm. This alarm level is to be used when the normal organisation needs extra support during unusual events that are of a lower class than those classified as Increased preparedness.

Two of the nuclear power sites have installed "rapid-reach" computerised systems for alarming the on-site organizations. These systems automatically dial predetermined numbers. The emergency staffs of each nuclear power plant are included in the general systems used at the plants for staffing, competence analysis, training and annual competence assessment.

During recent years, in connection with other development and refurbishment works, the owners of the facilities have improved their emergency facilities.

Relevant meteorological data from the power plants, the sites for the operation of spent fuel or radioactive waste management facilities and for the fuel processing facility are now electronically transferred directly into SSM's dispersion modelling database, enabling improved dispersion calculations to be performed.

To improve the flow of external information between all responsible parties involved in a nuclear accident, a new web-based system for national crisis information management has been introduced. The system aims at exchanging information and decisions taken in the event of an emergency, and is used nationally for all types of emergencies through the national agency MSB. The system has been used in exercises and improvements are made after evaluations. Currently, applications to improve system security are being investigated.

In order to make the first information transfer faster and more accurate between the affected plant and the off-site authorities, a standard electronic format has been recently developed. This format is now in regular use during incidents and exercises.

F.5.3 National monitoring

Sweden has acquired a new, modern gamma monitoring network which presently has 28 permanent gamma stations spread around the country designed to provide warning and rapid information on radiation levels. Each station records the radiation level continually and if the integrated 24-h radiation dose differs by more than 10 %, the officer on duty at SSM will be alerted. A fixed alarm level is currently set at 500 nanosieverts per hour (500 nSv/h) but the alarm level can be changed according to prevailing conditions.

Sweden also has six sensitive permanent air filter stations which sample the air continuously and can reveal the type of plant from which radioactive releases originate. The system is sensitive enough to measure activity levels in the order of tens of microBq/m^3 (about 100 atoms per cubic meter) and is therefore also used for environmental monitoring, e.g., for measuring the caesium-137 released from the combustion of biomass.

The gamma monitoring system is supplemented by radiation level data collected by the environmental and health care offices of the local authorities at permanent measurement points every seventh month in the municipalities, providing a background measurement base (sensitivity of 20-30 nSv/hour). The results of the measurements after deposition can be compared with these reference measurements which have been registered at 2 – 4 measurement points in each municipality. These data are collected from the municipalities by the county administrative board which compiles and transmits the readings to a national database. The Swedish municipal measurement system provides a base and is a system for quickly mapping the country in the event of radioactive fallout, and allows for detecting even small increases in radiation level at the reference points.

The Geological Survey of Sweden and the county police force are contracted for the use of aircraft and helicopters for airborne measurements of radiation. More detailed measurements are made to serve as a basis for decisions concerning, for example, declaring pasture land free of contamination for grazing.

SSM has agreements with laboratories around Sweden mostly at universities, under the terms of which they maintain a state of preparedness for making measurements and analyses and providing expert advice. SSM has also an agreement with the voluntary organizations of the Armed Forces, e.g. the Women's Voluntary Defence Service, the Women's Motor Transport Corps, and the Women's Auxiliary Veterinary Corps, for collecting needed field samples.

F.5.4 Medical emergency preparedness

The county administrative board is responsible for medical disaster preparedness. Injured persons are cared and treated

- through qualified medical care in the injury area, or
- in hospitals or at medical health centres.

At the major national hospitals, like Karolinska hospital in Stockholm, more advanced treatment and care can be arranged. Cooperation and sharing of resources also exists between the European hospitals in case of major accidents.

If there is an accident involving nuclear technology, the emergency organisation within SSM is activated. In the next alarm chain, the Swedish National Board of Health (SoS) is activated along with the Nuclear and Radiological Medical Expert Group (NR-MEG) appointed by the SoS. Several other authorities are also activated at the same time, depending on the scenario. Medical doctors from the medical areas haematology, oncology, radiology, and catastrophe medicine are represented within NR-MEG. The group has an on-call operation and is available for giving advice, also in connection with minor incidents, by contact through the officer on duty at the SoS. In case of a large accident, the group is summoned to the national emergency centre at SSM and is provided with information on radiation levels, meteorological conditions, etc. With the information available NR-MEG performs a medical risk judgement and delivers the information and suggestions for measures primarily directed to the medical doctor in charge at the county administrative board's rescue work management group. NR-MEG advises and informs the treating medical doctors and the medical care centres in the county.

To facilitate medical emergency preparedness in Sweden, SoS has established a Centre for Radiation Medicine, located at the Karolinska Institute in Stockholm. Among the tasks of this centre it has to contribute with health care information,

education, and advice and carry out research activities in areas related to medical effects of ionizing radiation. A close collaboration has been established with SSM and various other national and international bodies.

F.5.5 Exercises

A number of emergency preparedness exercises of various sizes are conducted annually in Sweden. These vary in complexity from simple tests of alarm systems to full-scale exercises. Periodical tests of the alerting systems between the power plants and the authorities are performed during each year.

Every second year a "total" exercise is performed at one of the three nuclear power sites to check the plans and the capability of the on-site and off-site organizations. The full-scale exercises are designed to enable evaluation of command at the regional level, national inter-agency cooperation, and public information. The full-scale exercises are often also used for testing international communications.

The respective county authority where the plant is located has the responsibility for planning these exercises, often with the assistance of the national agency MSB, which is also responsible for the evaluation and follow-up analyses. SSM participates in the planning and evaluation. Usually 15 - 30 organizations participate in these exercises, including the regulatory bodies and the government.
In addition, a number of more limited on-site functional exercises are conducted at all the Swedish plants every year. Specific plans exist for these exercises. Exercised functions are for instance accident management, communication within the emergency preparedness organisation, environmental monitoring and sampling, assessment of core damage and source terms and assessment of total environmental consequences of a scenario. The rescue forces are exercised regularly, as well as first aid and emergency maintenance. SSM frequently participates in such exercises both as observer, in its supervisory role, or to exercise the authorities' own emergency staff.

Other exercise scenarios have included physical protection events such as sabotage, armed intrusion, and the taking of hostages in order to exercise coordination between the special police forces and other actors. In the spring of 2011 a large national exercise, SAMÖ-KKÖ, was performed based on a loss-of-cooling accident and partial core melt at Oskarshamn NPP. It involved authorities and rescue organisations at central, regional and local level. The first phase, lasting for 48 hours, involved 3-shifts for the participating staffs, while the latter phase of 5-6 weeks was carried out by having the participating organisations solving problems, giving advice and suggesting countermeasures based on a radiological situation with wide-spread contamination resulting from the initial accident and its release of radioactive substances. During the latter phase of the national exercise, the March 11 nuclear accident at TEPCO Fukushima Dai-ichi NPP in Japan activated and engaged the central Swedish national emergency organisation for several weeks to follow.

Sweden has a long tradition of participating in international emergency preparedness exercises. This allows for testing of aspects related to bilateral and international agreements on early notification and information exchange. Sweden regularly participates in the IAEA Convention Exercises (CONVEX) and the OECD/NEA International Nuclear Emergency Exercises (INEX) and yearly ECURIE exercises.

F.5.6 Measures taken to inform neighbouring States

Sweden has ratified the International Convention on Early Notification and the Convention on Assistance in the Case of a Nuclear Accident. An official national point of contact has been established, available 24 hours all days. Sweden has bilateral agreements with Denmark, Norway, Finland, Germany, Ukraine and Russia regarding early notification and exchange of information in the event of an incident or accident at a Swedish nuclear power plant or abroad. An agreement at the authority level also exists with Lithuania. Sweden uses the ECURIE information system for information exchange within the European Union and the ENAC/Emercon system for information exchange between the IAEA member states.

The Nordic authorities involved in radiological emergency planning have agreed to exchange data on a routine basis from the automatic gamma monitoring stations in the respective countries. The five Nordic countries Denmark, Finland, Iceland, Norway and Sweden have compiled a Nordic Manual describing communication and information routines between the countries for an extensive list of scenarios, which has been agreed upon by these five countries.

F.5.7 Nuclear accidents abroad

As demonstrated by the Chernobyl accident 1986, Sweden can be affected by a nuclear accident abroad. Although the foreseeable consequences are such that the use of iodine tablets, sheltering or relocation of people due to fall-out is not likely in Sweden, the impact on agriculture, animal breeding, forestry, hunting, recreation, and private house-hold activities (fishing, picking mushrooms, game hunting, vegetable gardening, etc.) and on the environment can be substantial due to the uptake and concentration of radioactive substances in plants, animals and human food-chains.

The responsibility of SSM and other authorities to distribute information is strengthened in this situation. The local county administrative boards that are affected still have the responsibility to inform and take any protective action in their region according to the earlier mentioned legislation. During the national exercise South Wind in 2008 the responsibilities of national and regional authorities were tested. Ambiguities in allotment of rolls and responsibilities were analysed.

The Swedish Meteorological and Hydrological Institute, SMHI, performs transport and deposition simulations regularly using the program MATCH (a 3-dimensional “off-line” Eulerian atmospheric transport code) and the actual weather. A hypothetical standard release of radioactive substances from the Swedish and some of the nuclear reactors in operation in other countries around the Baltic Sea is tracked by this computer code and the calculations are updated every sixth hour using actual weather. The transport, spread, and concentration of the simulated, released radio-nuclides are displayed.

Furthermore, the MATCH-trajectory simulations are also available for tracing the source regions for recorded measurements at specific measurement points. For a few selected places in Sweden, such backward direction trajectories can be followed for the last 72 hours. Although the nuclear accident at the TEPCO Fukushima Dai-ichi NPP did not have radiological consequences in Sweden, the Swedish emergency organisation was activated and worked around the clock for three weeks analysing and evaluating the situation in order to give advice to the Swedish Embassy and Swedish citizens in Japan.

F.5.8 New developments in emergency preparedness

The County Administration Boards in the counties that have nuclear plants and the national authorities MSB and SSM have established an action plan including a variety of projects aimed at enhancing a coordinated emergency planning and response for nuclear power plant accidents and incidents. These projects are ongoing and have different completion dates, the latest being in 2012. These projects aim at mitigating identified needs in the organisation of education and exercises, coordinating communication, coordinating national and regional measurement and analysis teams, further developments in and coordinating of sanitation procedures and creating a national information strategy.

SSM has supported further developments in Sweden's dispersion modelling capabilities in cooperation with the SMHI and the Swedish Defence Research Agency. The resolution of the dispersion prognosis has been enhanced by using higher resolution weather forecasts. A code for urban dispersion modelling has been developed with special emphasis on wind field modelling in urban environments. This can be applied locally to the topography at the Swedish plants. SSM is currently compiling high resolution topographical data sets for all the Swedish nuclear installations thereby enabling better estimates of the near field dispersion. This is further enhanced by the new feature of local weather data at each plant being sent electronically directly to the database for the dispersion modelling in real time.

The merging of SSI and SKI into a single regulatory authority, SSM, has resulted in a more effective thorough supervision of the nuclear installations in Sweden.

On May 25 2011, as follow-up to the nuclear accident at the TEPCO Fukushima Dai-ichi NPP and in accordance to the EU "stress tests" specifications, SSM decided that the licensees of the nuclear power plants and SKB, as licensee of Clab, shall re-evaluate their safety analyses for their facilities regarding station black-outs, loss-of-cooling etc. as a result of severe winds, flooding or other natural phenomena. Furthermore, regardless of the initiating events, the capacity and the capability of the emergency organisation and the effectiveness of technical equipment and planned countermeasures to handle an emergency in a situation with destroyed infrastructure, loss of external power and severe contamination in the surrounding area shall be evaluated. The results of analyses and safety evaluations, and identified measures to further improve the emergency preparedness or the ability of the facility to handle severe accident scenarios should be reported to SSM before October 31, 2011.

F.5.9 Regulatory control

After the implementation of the SSI regulations concerning emergency preparedness at certain nuclear facilities in 2006, a series of inspections was carried out in 2007 and 2008 at all of the nuclear facilities that were covered by the regulations to insure implementation had been properly carried out. The conclusion was that the licensees complied with the requirements of the regulations. At all sites, however, aspects for further improvements were identified and SSM has continued to follow up these findings during 2008 - 2011.

The merging in July of 2008 of SSI and SKI into a single authority, SSM, has provided the conditions for a more clear and consistent picture of the requirements that came from the combined regulations of the two earlier authorities. Supervision of emergency preparedness regulations is now concentrated to one national

coordinating authority and the main responsibility for the supervision is organised within one section at that authority, which also provides a basis for a clearer supervisory role at the authority. The various relevant competences within the authority that are needed for the supervisory work are available and can be more effectively integrated in the supervision work than was possible earlier. This has led to more effective developments in the supervisory work as well as an increased number of inspections in a year.

One development which began during 2009 and is currently progressing concerns a review of the regulations (SSMFS 2008:15) and (SSMFS 2008:1) which came from the earlier SSI and SKI, respectively, with the intention to combine and harmonize all aspects of regulating emergency preparedness at the licensees, and to use the earlier experiences from the implementation of the regulations to revise the regulations with the expected result of clearer and stronger requirements on the nuclear installations.

F.5.10 Conclusion

Sweden complies with the obligations of Article 25.

F.6 Article 26: DECOMMISSIONING

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

(i) qualified staff and adequate financial resources are available;
(ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;
(iii) the provisions of Article 25 with respect to emergency preparedness are applied; and
(iv) records of information important to decommissioning are kept.

F.6.1 Regulatory requirements

According to the Environmental Code prior permission is needed for decommissioning and dismantling. As described in Section E.2.2.4 the applicant has to show compliance with a number of principles, e.g. the knowledge principle, the precautionary and BAT principles, and the after-treatment liability principle.

F.6.1.1 Nuclear safety

According to the Act on Nuclear Activities (SFS 1984:3), the license-holder for nuclear activities shall be responsible for ensuring that all measures are taken needed for:

- maintaining safety, taking into account the nature of the operation and the circumstances in which it is conducted,
- safe management and disposal of nuclear waste generated by the operation or nuclear material derived from the operation that is not reused, and
- safe decommissioning and dismantling of facilities in which the operation shall be discontinued until such date that all operations at the facilities have ceased and all nuclear material and nuclear waste have been placed in a disposal facility that has been sealed permanently.

It follows from the third paragraph that a license-holder is not exempted from responsibilities according to the act until decommissioning and dismantling has taken place. The general regulations SSMFS 2008:1 contains a chapter on decommissioning with requirements on:

- A preliminary plan for the future decommissioning of the facility to be compiled as before construction of a facility.
- An integrated analysis and assessment of how safety is going to be maintained during the time remaining until closure, to be done as soon as a decision has been taken on final shutdown of a facility.
- The decommissioning plan to be supplemented and incorporated into the facility's safety report before the dismantling of the facility may be initiated.

The plan shall include measures, which must be implemented to ensure the safe containment of the generated nuclear waste. Thus, the general obligations in the regulations SSMFS 2008:1 and several other regulations (see section F.6.1.2) are applicable for the decommissioning and dismantling activities, regarding:

- the availability of qualified staff and financial resources (as accounted for in section F.2);
- the application of provisions with respect to operational radiation protection, discharges and unplanned and uncontrolled releases (as accounted for in section F.4);
- the application of provisions with respect to emergency preparedness (as accounted for in section F.5); and
- the keeping of records of information important to decommissioning.

F.6.1.2 Radiation protection

Most of the regulations on radiation protection that are applicable at nuclear facilities are also valid during decommissioning (see section F.4).

The regulations SSMFS 2008:38 requires filing of documentation at nuclear facilities. The licence-holder shall keep archives where documentation related to radiation protection aspects of a practice shall be filed. If the practice ceases the archives shall be handed over to the National Archives of Sweden or Regional Archives. Detailed requirements on keeping a register for the radioactive waste and nuclear waste at nuclear facilities are given in SSMFS 2008:22. The register shall e.g. contain information on the origin of the waste and the amount and nuclide specific content of the waste.

Planning of radiation protection issues before and during the decommissioning of nuclear plants is regulated in SSMFS 2008:19. The regulations put requirements on planning, both during operation and after final shutdown. The main purpose of the regulations is to ensure that worker doses and releases of radioactivity to the environment during decommissioning are in accordance with ALARA principles and within specified limits, by requiring adequate planning of the decommissioning activities in advance. The contents of the regulations are described below.

Area of application
The regulations SSMFS 2008:19 are intended to be applicable to all nuclear facilities, except permanent installations in repositories for radioactive wastes (such parts that will remain after closure).

Definitions
The term ”decommissioning” is used to describe all actions taken by the licence-holder after final shutdown in order to reduce the amount of radioactive substances in the land and building structures to levels that permit release of the site and any buildings left behind.

The term ”release of site” is used to describe a decision by the SSM that, from a radiation protection point of view, there are no further restrictions on the use of land and any remaining buildings.

The term ”finally shutdown facility” is used to describe a facility in which the main operations have ceased with no intention to resuming them.

New or reconstructed facilities
It is required that radiation protection issues of the future decommissioning shall be considered during construction of a new nuclear facility or when an existing facility is reconstructed.

Decommissioning plans
For nuclear facilities in operation, the main requirement of the regulations is that the licence-holder shall have a preliminary plan for future decommissioning of the facility. The plan shall be kept up-to-date and reviewed in connection with changes in the facility. The regulations do not prescribe how or when decommissioning shall be performed. Instead, the regulations demand that the licence-holder investigates different possible options in order to make an optimised choice.

Finally shut down facility
When a facility has been finally shut down, the regulations require that the licence-holder present an overall description of the foreseen decommissioning, covering methods, time-scales and project goals. The description shall be submitted to SSM within one year of the final shutdown, together with an overall description of the radiological consequences of the chosen decommissioning option. The description shall cover probable radiation doses to personnel and releases of radioactive substances to the environment, activities that can lead to unplanned events, and the expected amounts and flow of radioactive material.

Dismantling and demolition after final shutdown
The regulations require that the licence-holder shall submit an overall description of the work to the SSM at least four months before dismantling is initiated. The description shall essentially be a detailed plan of the foreseen activities, covering the same issues as the pre-planning. SSM will review the plan and, if required, impose additional radiation protection conditions on the work.

Basis for site release
After decommissioning, the licence-holder should prove that the site could be released from regulatory control. Therefore the regulations require that the licence-holder shall document relevant information during decommissioning. The documentation shall contain results from measurements and calculations, as well as information concerning decisions and actions taken that have influence on the distribution and the amount of remaining radioactive substances.

Further guidance need to be developed concerning radiological criteria and for free release of a site.

F.6.2 Measures taken by the license holders

The nuclear power companies are responsible for decommissioning of the nuclear power plants. SKB has been assigned the task of conducting general decommissioning studies in order to ensure that that overall necessary competence exists and that cost calculations are carried out according to requirements. SKB and the nuclear power companies participates in various international decommissioning studies undertaken by international organizations, and also by direct contact with various decommissioning projects that may be of value for planning activities in Sweden.

Management of decommissioning waste is coordinated through SKB and

SKB has also been tasked with the future disposal of decommissioning waste. For division of responsibility see figure F3.
A method for dry interim storage of core components has since earlier been developed, along with a database system for record keeping. The existing BFA storage facility on the Simpevarp Peninsula, as well as storage facilities at Ringhals and Forsmark power plants and at the Studsvik site are used for interim storage of core components and other long lived waste.

Commercial power plants
As basis for the cost estimates (see section E.2.2.5) cost calculations have been made for two reference NPPs, Oskarshamn 3 (BWR) and Ringhals 2 (PWR) and then transferred to the other NPPs. The cost estimates have during 2010 been updated with the results from more recent decommissioning studies of Barsebäck 1 and Barsebäck 2, which were finalised during 2008.

Preliminary decommissioning plans have been developed for all the Swedish nuclear power plants during 2005 and 2006.

The nuclear power reactors Barsebäck 1 and Barsebäck 2 has been adapted to shut down operation. A decommissioning plan for both units has been submitted to, and approved of, by the regulatory authorities. All nuclear fuel has been removed and transported to Clab for interim storage. System decontamination has been carried out for both reactors and dismantling is planned to start in 2020. Dismantling waste management and transportation will be carried out as an industrial process where low radiation doses are prioritized. Clearance measures will only be carried out when a significant advantage can be seen in an ALARA perspective.

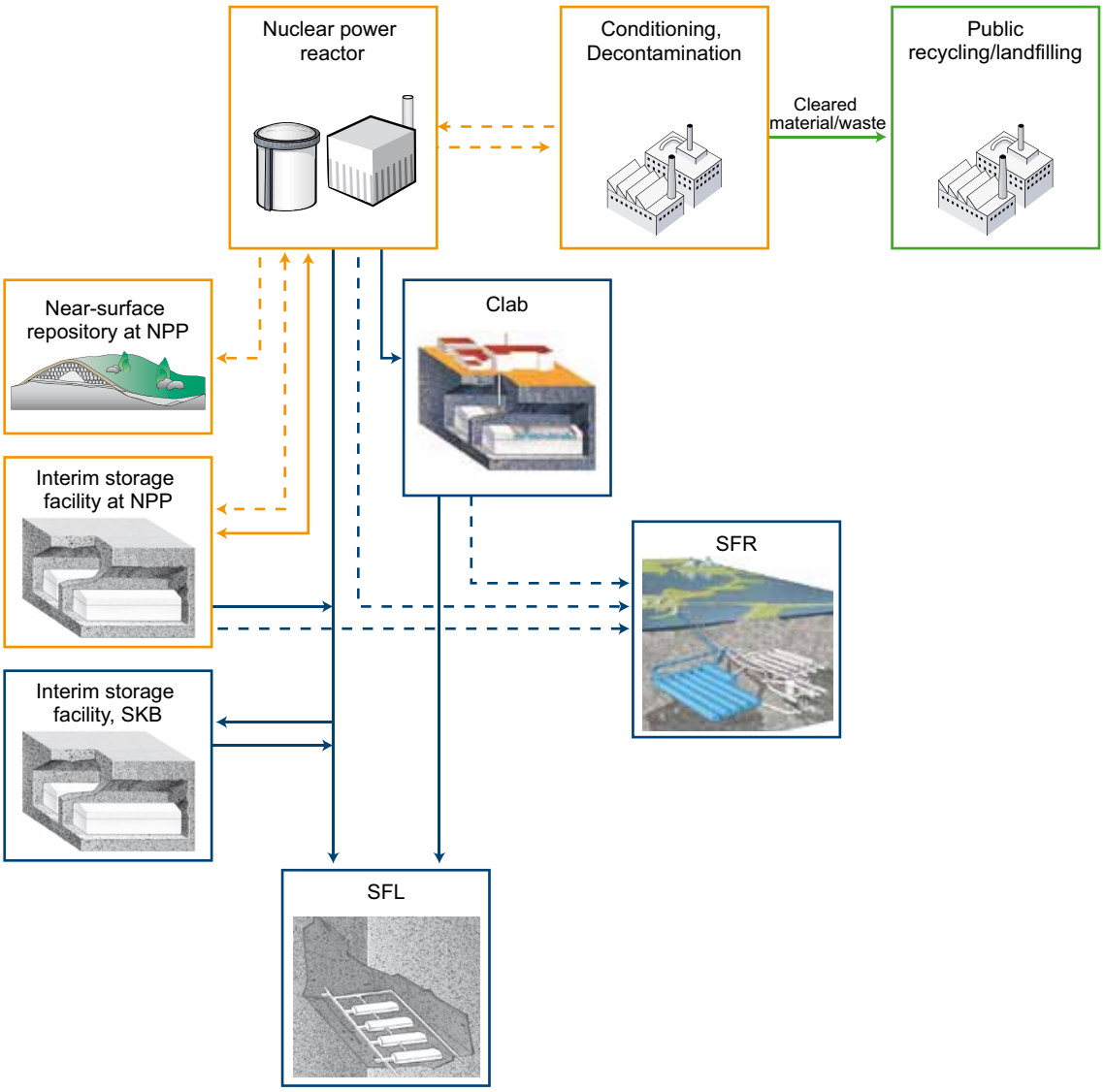


Figure F3: Division of responsibility during decommissioning

Research facilities
There are a number of facilities at the Studsvik site that are in the process of being decommissioned and/or dismantled. Plans for the decommissioning and dismantling of those facilities have, before actual decommissioning activities started, been prepared by the license-holders and submitted to SSM for evaluation and approval, according to requirements in the general regulations. The status of the facilities under decommissioning is accounted for in section D.1.5.

SKB facilities
For Clink a preliminary decommissioning plans have been written which conforms to the requirement of the regulatory authorities. SKB plans to prepare a decommissioning study of Clink focusing on waste volumes and radioactivity content, during 2011 as a basis for extension of SFR.

Planning for an extension of SFR began during 2007. The extension will give opportunity for disposal of decommissioning waste from primarily Barsebäck, and be ready for operation by 2020. Investigations of the bedrock have been performed. Work with a preliminary safety analysis report (PSAR) and an environmental impact statement (EIS) is ongoing. According to the plans, the construction application will be submitted to the regulatory authorities in 2013. SKB has written a simplified account of how decommissioning for SFR is planned to be carried out. This is due to that the above ground facilities can be regarded as conventional buildings.

A preliminary decommissioning plan have been written for the spent fuel disposal facility and was included in the application under the Act (1984:3) on Nuclear Activities for disposal of spent fuel and under the Environmental Code for the KBS-3 system.

Investigation of different concepts for the disposal facility for long-lived low- and intermediate waste (SFL) was started 2011. A safety evaluation of at least two different concepts is planned for 2013. SFL is not expected to start operation until 2045. No decommissioning plans have yet been written for SFL.

F.6.3 Regulatory control
Regulatory control is conducted by means of the regulatory review and approval of plans for decommissioning and dismantling, both according to regulations (requirements on information and on safety assessments), the Environmental Code (applications for licenses and environmental impact assessments) and the Act on Nuclear Activities (R&D-programme presented by the NPP operators every third year), complemented by inspection activities at the sites, as necessary.

F.6.4 Conclusion
Sweden complies with the obligations of Article 26.

G.1 Article 4: GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards. In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;
(ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;
(iii) take into account interdependencies among the different steps in spent fuel management;
(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;
(v) take into account the biological, chemical and other hazards that may be associated with spent fuel management;
(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;
(vi) aim to avoid imposing undue burdens on future generations.

G.1.1 Regulatory requirements

G.1.1.1 The general obligations of license-holders

As accounted for in section E.2.2.1, the Act (1984:3) on Nuclear Activities (1984:3) requires that the holder of a licence for the operation of a nuclear power reactor shall – in co-operation with the other holders of a licence for the operation of nuclear power reactors – establish and carry out an R&D-programme for the safe handling and disposal of spent fuel and nuclear waste. Every third year the programme shall be submitted to the Government, or an authority assigned by the Government, for evaluation.

Also, as accounted for in section E.2.2.5, the Financing Act (2006:647) requires the licensees to submit, every three years, estimates of all future costs for management and disposal of spent nuclear fuel and nuclear waste, and decommissioning. The licensee of a nuclear power reactor shall base costs estimates on 40 years of operation with a minimum remaining operating time of 6 years. The licensee of nuclear facilities other than nuclear power reactors shall base cost estimates and the buildup of adequate financial resources on the expected remaining period of operation.

G.1.1.2 Basic provisions and license obligations

Basic safety provisions are stipulated in the Act on Nuclear Activities (1984:3). The requirements are further clarified in the general safety regulations SSM 2008:1. In the regulations it is stated that, in order to ensure adequate protection at all stages of spent fuel management, the licensee shall:

1. establish documented guidelines for how safety shall be maintained at the facility as well as ensure that the personnel performing duties which are important to safety are well acquainted with the guidelines;
2. ensure that the activities carried out at the facility are controlled and developed with the support of a quality system which covers those activities which are of importance for safety;
3. ensure that decisions on safety-related issues are preceded by adequate investigation and consultation so that the issues are comprehensively examined;
4. ensure that adequate personnel is available with the necessary competence and suitability on all respects needed for those tasks which are of importance for safety as well as ensure that this is documented;
5. ensure that responsibilities and authority are defined and documented with respect to personnel carrying out work which is important to safety;
6. ensure that the personnel is provided with the necessary conditions to work in a safe manner;
7. ensure that experience from the facility's own and from similar activities is continuously utilised and communicated to the personnel concerned; and
8. ensure that safety, through these and other measures, is maintained and continuously developed.

In the Radiation Protection Act (1988:220) it is stipulated that radioactive waste shall be handled and disposed of in a manner that is satisfactory from a radiation protection point of view.

There are also regulations on the protection of human health and the environment in connection with the final management of spent nuclear fuel and nuclear waste (SSMFS 2008:37). The purpose of these regulations is to limit the harmful effects on human health and the environment in connection with the disposal of spent nuclear fuel and nuclear waste.

In addition there are requirements concerning the long-term safety of a disposal facility in the regulations SSMFS 2008:21. According to the regulations, the safety assessment for a disposal facility should also comprise features, events and processes that can lead to the dispersion of radioactive substances after closure.

G.1.1.3 Criticality and removal of residual heat

The general safety regulations (SSSM 2008:1) state that radiological accidents shall be prevented by the design, construction, operation, monitoring and maintenance of a facility. It follows that a criticality analysis as well as an analysis of heat generation and removal of residual heat must be included in the safety report supporting the licence application for any nuclear facility.

G.1.1.4 Interdependencies among the different steps in spent fuel management;

The fact that the licence-holders are responsible for the handling and disposal of the spent nuclear they generate provides an incentive to consider all steps from generation to disposal. Detailed requirements are stipulated in SSM's general regulations SSMFS 2008:1. Measures for the safe on-site handling and storage of spent fuel shall be analysed and verified, and included in the safety report of the facility. The safety report shall also include measures, which need to be taken on-site to prepare for the safe subsequent transportation, storage or disposal of spent fuel.

G.1.1.5 Protection of individuals, society and the environment

General radiation protection provisions are described in section F.4.1. Radiation protection of the public and the environment in connection with spent fuel management is specifically addressed in SSM regulations 2008:37 and 2008:21, see also E.2.2.3). In summary it is required that:

- a disposal facility for spent nuclear fuel shall be designed so that the annual risk of harmful effects after closure does not exceed 10E-6 for a representative individual in the group exposed to the greatest risk;
- disposal of spent nuclear fuel shall be implemented so that biodiversity and the sustainable use of biological resources are protected, and
- human health and the environment shall be protected during the operation of a nuclear facility as well as in the future.

G.1.1.6 Biological, chemical and other hazards

An Environmental Impact Statement (EIS) must be submitted together with an application for a licence according to the Act on Nuclear Activities and the Radiation Protection Act, as accounted for in section E.2. It is stated in the general considerations in the Environmental Code that due consideration shall be taken to possible effects from chemical, biological and other hazards. It follows that chemical, biological and other hazards during the operation of a nuclear facility must be addressed in the EIS.

Post-closure safety for a disposal facility is specifically addressed in SSMFS 2008:21.

G.1.1.7 Strive to avoid actions that impose impacts on future generations

One purpose of SSMFS 2008:22 is to limit the harmful effects of radiation from the waste today and in the future. In SSMFS 2008:23 it is also stated that human health and the environment shall be protected from the harmful effects of ionising radiation during the operation of a nuclear facility as well as in the future. SSMFS 2008:37 has general requirements stipulating that human health and the environment shall be protected from detrimental effects of ionising radiation, during the time when various stages of the final management of spent nuclear fuel or nuclear waste are being implemented as well as in the future. All these regulations strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation.

G.1.1.8 Aim to avoid imposing burdens in future generations

As described in section E.2 the practices for the management of spent fuel and radioactive waste are governed by principles adopted by the Swedish Parliament. The first governing principle reads ”The expenses for the disposal of spent nuclear fuel and nuclear waste are to be covered by revenues from the production of energy that has resulted in these expenses.” The second principle reads”The reactor owners are to safely dispose of spent nuclear fuel and nuclear waste.”

The key words (underlined) imply that burden on future generations should be avoided, especially with regard to the fundamental aspects of safety and costs. The key words also imply that action should be taken without postponement, i.e. the generation that has benefited from the nuclear power generation should also deal with the management and disposal of spent nuclear fuel.
Also, the holder of a licence to operate a nuclear facility is primarily responsible for the safe hand- ling and disposal of spent nuclear fuel and radioactive waste, as well as decommissioning and dismantling the facility.

G.1.2 Measures taken by the license holders

G.1.2.1 The general obligations of license-holders

Cost calculations
Cost calculations have since the beginning of the 1980’s been submitted by the license-holders of a nuclear reactor, in cooperation with the other holders of a license for the operation of nuclear power reactors, on an annual basis.SKB submitted in January 2011 the most recent cost calculations under the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities.

RD&D Programme 2010
The nuclear industry, through its co-owned company SKB, has performed research on final disposal of radioactive waste since the mid-1970’s. The formal requirement for a R&D-programme to be submitted for regulatory evaluation was established in 1984 when the Act on Nuclear Activities was promulgated. During the 1990s the research was intensified with extensive feasibility studies (in eight municipalities). In 2001-2002 two municipalities approved further investigations. The initial site investigations were concluded by the end of 2007 and the results reported in preliminary site descriptions. In June 2009 the board of SKB decided to choose Forsmark as site for the disposal facility for spent nuclear fuel. In March 2011, SKB’s applications for a permit to build a disposal facility system were submitted to the Swedish Radiation Safety Authority (SSM) and the Environmental Court in Stockholm. Since 1986 SKB has produced nine R&D programmes with KBS-3 as the main alternative for the disposal of spent fuel. SKB submitted in September 2010 the ninth RD&D-programme to the Government.

G.1.2.2 Basic provisions and license obligations

Measures taken by the licensees regarding general safety requirements are to be found in sections G.3.2, G.4.2, G.5.2 and G.6.2.

Central storage for spent nuclear fuel (Clab)

The most important spent fuel facility in Sweden is the interim storage for spent nuclear fuel (Clab) located at the OKG site. SKB is the licensee for Clab. SKB took over the operation of Clab, previously contracted out to OKG, in January 2007. SKB has implemented the requirements in the general regulations SSMFS 2008:1 in its operating organization. The organizational structure of SKB as well as the management system has been amended to reflect this change.

Clab has been in operation since 1985. Prior to the introduction of the general regulations the requirement for a periodic safety review (PSR) was a condition in the NPP licenses. In the general regulations SSMFS 2008:1, the requirement for periodic safety reviews is now mandatory for all nuclear facilities.

The fuel storage pools in Clab were expected to be completely filled early 2004. Therefore in 1996 SKB initiated a project to increase the storage capacity from 5 000 to 8 000 tons of fuel by excavating a new rock cavern to provide additional storage pools.

The construction of the new storage pools (Clab 2) was completed during 2004. SKB submitted an application for a license to take the pools in operation in December 2004, supported by an updated safety report. The regulatory authority requested amendments to the updated safety report and SKB submitted a new revision of the report in 2005.

In the beginning of 2006 problems with movement joints in a transport channel between the existing and the newly built storage pools were encountered. No storage was permitted in Clab 2 until the problem was solved. SKB developed a new technical solution for the movement joints which was agreed by the regulatory body in April 2007. Rebuilding work of the transport channel was carried out and Clab 2 was taken in operation 2008-01-01 after an affirmative regulatory decision based in e.g. regulatory approval of a renewed safety analysis report (SAR) for the extended facility.

Spent fuel from the research reactor R1 in Studsvik

During 2007 the intact parts of the R1-fuel (see chapter D.1.1) was separated from corroded parts, in the form of powder and lumps, and transported to the United Kingdom. The intact parts were reprocessed in 2008. The fissile material from the reprocessing of the R1-fuel are planned to be manufactured to MOX-fuel and the other remaining waste from the reprocessing have been sent back to Sweden in 2009. The waste is temporarily stored at the Studsvik site before transport to disposal facility.

The corroded parts of the R1-fuel are still temporarily stored at the Studsvik site before transport to the disposal facility.

G.1.3 Regulatory control

G.1.3.1 The general obligations of license-holders

Nuclear waste fees and guarantees for 2010 and 2011
SSM reviewed the cost calculations and submitted a statement with suggestion for the size of fees and guarantees to the Government in October, 2009. The Government decided in December 2009 on the size of fees and guarantees for 2010 and 2011. SSM is currently reviewing the most recently submitted cost calculations to determine and suggest to the Government the size of fees and guarantees for 2012 through 2014.

Evaluation of the RD&D Programme 2010
SKB submitted in September 2010 the RD&D-programme 2010. The regulatory authorities have evaluated the programme and submitted a statement to the Government. The main conclusions from the regulatory review were:

- The account for the ongoing site investigations and other preparatory work to support a license application for the extension of the disposal facility for short-lived low- and inter mediate level waste could have been more detailed. SSM therefore recommended the Government to require SKB to conduct consultations with SSM, in order to be appropriately informed about the regulatory requirements on contents and quality of the collection of arguments and evidence ("Safety Case") in support of the application, planned to be submitted in 2013.
- SKB should, in close cooperation with the nuclear power reactor operators, further detail and develop the planning for decommissioning of the reactors as well as the assessments of different categories of waste expected to be generated during decommissioning.
- SKB should in the next RD&D-programme to be submitted in 2013, further develop detailed planning for the establishment of a disposal facility for long-lived low- and intermediate level waste.

G.1.3.2 Basic provisions and license obligations

Regulatory control of measures taken by the licensees regarding general safety requirements are to be found in G.3.3, G.4.3, G.5.3 and G.6.3.

The licence application for Clab included a criticality analysis as well as an analysis of heat generation. A re-assessment of both the criticality analyses and heat generation was performed and submitted 1997 in the application to extend the facility as well as in the application to start operation of the extended facility.

The regulatory authority monitored the extension works at Clab closely and approved the start of operation of the Clab2 in December 2007 and the extended part of the facility was taken in operation in the beginning of January 2008. The authorization includes the condition that SKB shall carry out the prepared inspection programme and that the results shall be documented and reported. The inspection programme includes monitoring of pool temperatures, pool movements and dose loads.

G.1.4 Conclusion

Sweden complies with the obligations of Article 4.

G.2 Article 5: EXISTING FACILITIES

> Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

By the time the Joint Convention entered into force for Sweden the situation as regards safety of spent fuel management facilities was satisfactory.

The elements of the Joint Convention are since long implemented as requirements in the legal and regulatory framework and implemented in the management of spent fuel. Dedicated inspection and review activities carried out in the early 2000's confirmed that the licensee's activities were in conformance with the legal and regulatory requirements. This conclusion has been reaffirmed during subsequent inspection and review activities.

Sweden complies with the obligations of Article 5

G.3 Article 6: SITING OF PROPOSED FACILITIES

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:
   (i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;
   (ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;
   (iii) to make information on the safety of such a facility available to members of the public;
   (iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.
2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.

G.3.1 Regulatory requirements

G.3.1.1 Assessment of safety and environmental impact

According to the Act on Nuclear Activities a licence is required to construct, possess and operate any nuclear facility. A licence application must contain an EIA. The procedures for carrying out the EIA, as well as its contents, are specified in the Environmental Code (see section E.2.2.4). The licensing procedure is described in section E.2.3.1. The EIA must contain the following elements:

- A description of the activity or measure with details of its location, design and scope.
- A description of the measures being planned with a view to avoiding, mitigating or remedying adverse effects.
- The information needed to establish and assess the main impacts on human health, the environment and management of land, water and other resources that the activity or measure is likely to have.
- A description of possible alternative sites and alternative designs, together with a statement of the reasons why a specific alternative was chosen and a description of the consequences if the activity or measure is not implemented.
- A non-technical summary of the information.

In addition to the EIA the preliminary safety report for a proposed spent fuel management facility is of key importance for licence application. Requirements on the content of the safety report are given in the general regulations concerning safety in certain nuclear facilities (SSMFS 2008:1), and include for example:

- A description of how the site and its surroundings, from the standpoint of safety, can affect the facility.
- A description of the design basis, including the requirements that have determined the design and construction of the facility. Descriptions of facilities for the handling of spent fuel or nuclear waste shall contain requirements that are determined by the description of safety in the particular disposal facility after closure.
- A description of measures taken to ensure adequate protection of workers, the public and the environment from radiation, as required by the Radiation Protection Act and regulations promulgated according to that act.

As described in section E.2.2.1 the operators of nuclear power plants must jointly perform a comprehensive R&D-programme for the safe management of spent nuclear fuel and nuclear waste. The purpose of this programme is to demonstrate that timely actions are taken to evaluate the safety and impacts of proposed facilities and that all relevant site-related factors are studied. The programme must be submitted every third year for regulatory review.

G.3.1.2 Public information and involvement

There are several procedures that serve the purpose to involve the public in the siting of new spent nuclear fuel and nuclear waste facilities. As mentioned above, an EIA must be performed for any new nuclear facility. Swedish legislation emphasizes the role of the public and other stakeholders in the EIA. The developer must initiate early (long before a licence application is submitted) consultations with those parties that might be affected by a new facility.

Parties that must be consulted include:

- municipalities that may host the facility;
- regulatory authorities, primarily SSM and County Administrative Boards;
- national environmental organisations;
- local interest groups; and
- affected individuals, e.g. those living close to a proposed location.

The County Administration Boards have an important function besides participating in the consultations. They are requested to assist the developer in identifying stakeholders and to facilitate consultations and an exchange of information.

Furthermore, the circulation of the nuclear power plants' joint R&D programme for comments provides a broad range of concerned parties with information regarding new facilities as well as a possibility to state opinions.

According to the Act (1992:1537) and Ordinance (1981:671) on the Financing of Future Expenses for Spent Nuclear Fuel etc., the municipalities that might host a spent nuclear fuel or nuclear waste facility, including a disposal facility, are reimbursed for their own information to the public. Municipalities have been reimbursed for their information activities since the mid-1990s. Currently the mu-

nicipalities of Östhammar and Oskarshamn are receiving reimbursement. In 2004 the Parliament approved a new regulation in the Financing Act, which made it possible for non-profit-making organisations to apply for financing. Non-profit-making organizations are entitled to financial support from the Nuclear Waste Fund until 12 months after the Environmental Impact Assessment has been announced by the Environmental Court (for details see section E.2.2.5). Decisions concerning reimbursement to municipalities and non-profit organisations are made by SSM.

G.3.1.3 Consulting contracting parties

The Environmental Code specifies that if another country is likely to be affected, the responsible authority as designated by the Government shall inform the competent authority in that country about the planned activity. The country concerned, and the citizens, who may be affected, should be given the opportunity to take part in the consultation procedure. The Government has designated the Swedish Environmental Protection Agency to be responsible for this task. Such information shall also be supplied when another country, which is likely to be exposed to a significant environmental impact, so requests.

G.3.2 Measures taken by the license holders

G.3.2.1 General

All planned spent fuel and nuclear waste facilities, including repositories, will be sited, constructed and operated by SKB. The supporting RD&D-programme is also run by SKB. The following activities are currently carried out by SKB:

- The RD&D-programme has been reported every third year since 1986. The most recent RD&D report was submitted in 2010.
- Consultations and an EIA for the planned encapsulation facility (Clink) and the disposal facility for spent nuclear fuel began formally in 2002, but in practice started in the mid-1990's. The consultations were concluded in May 2010.

G.3.2.2 Site selection for the spent fuel disposal facility

A big challenge for SKB has been selecting a site for disposal. The Environmental Code states that "in the case of an activity or measure for whose purposes a land or water area is used, a site shall be chosen that is suitable in order to achieve the purpose with a minimum of damage and detriment to human health and the environment"

The prospects for achieving the purpose of disposal are dependent on the properties of the bedrock. The fundamental requirement on the site that is chosen is therefore that there is rock at the site that can satisfy the safety requirements. In order for the site to be available and the project to be feasible, there must also be acceptance in the concerned municipality and among nearby residents. These basic requirements have guided SKB's siting work. In order to find the most suitable site, SKB has conducted general siting studies (general and regional compilations and analyses), feasibility studies (comprehensive compilations and analyses of siting prospects at the municipal level) and site investigations (comprehensive investigations of bedrock and biosphere on selected sites).

In various RD&D decisions, the Government has made declarations on the need for background material for site selection. In a decision in May of 1995, the Government stated that future applications for a licence to build a disposal facility should contain material that shows that site-specific feasibility studies have been conducted at between 5 and 10 sites in the country and that site investigations have been conducted at at least two sites. The statement has been repeated with partly varying formulations in several Government decisions concerning SKB's RD&D programmes. SKB conducted feasibility studies in eight municipalities between 1993 and 2000: Storuman, Malå, Östhammar, Nyköping, Oskarshamn, Tierp, Älvkarleby and Hultsfred. After municipal referendums in 1995 and 1997, the municipal councils in Storuman and Malå said no to continued investigations in their respective municipalities. At the end of 2000, SKB presented its conclusions from the feasibility studies of the different sites and a programme for continued site investigations. Both geological and industrial prospects as well as environmental and societal aspects were evaluated. Eight siting alternatives were judged to be sufficiently promising to warrant further studies. SKB also drew the conclusion that the KBS-3 method was well-developed and ready to move into an implementation phase. The Government's decision on RD&D-K* in November 2001 was unequivocal: "The Government judges that the company should use the KBS-3 method as a planning premise for the upcoming site investigations."

SKB made a selection and wanted to conduct site investigations in three areas situated in the municipalities of Östhammar, Oskarshamn and Tierp. SKB also wanted to conduct additional evaluations of an area in Nyköping Municipality, but the municipal council in Nyköping decided in May 2001 not to participate any longer in SKB's siting process. Tierp Municipality withdrew in 2002 and was thereby no longer a candidate site. In Östhammar and Oskarshamn, clear majorities of each municipal council spoke in favour of the proposed site investigations. In 2002, after the decisions and agreements with these two municipalities, SKB commenced site investigations in the Forsmark area in Östhammar Municipality and in an area in Oskarshamn Municipality that included the Simpevarp Peninsula and the Laxemar area. The investigations could gradually be concentrated on a smaller area in Forsmark and on the Laxemar area west of Simpevarp. In the field investigations SKB has conducted in these areas, great resources have been devoted to collecting the data on the properties of the bedrock, the soil layers and the ecosystems that are needed to analyse the prospects for a safe disposal facility. Obtaining the necessary knowledge of the properties of the rock has required drilling boreholes to and below disposal facility depth on a large scale. In June 2009, with the support of these investigations, SKB made its selection of a site for a future disposal facility: Forsmark in Östhammar Municipality.

The site was selected after a systematic evaluation and comparison of the two final alternatives, Forsmark and Laxemar. The prospects for post-closure safety were paramount in the evaluations. The advantages of Forsmark in relation to Laxemar when it comes to the prospects of achieving a disposal facility that satisfies the safety requirements are clear. The main reason is that there are few water conducting fractures in the rock at disposal facility depth, which means that the

** The Governments decision on RD&D-programme 1998 included requirements on SKB to submit supplementary material, which was denominated RD&D-K.*

groundwater flow through the disposal facility is greatly limited. This provides great advantages for the long-term performance of the copper canister and the bentonite clay. The dry and fracture-poor rock at disposal facility level in Forsmark also offers advantages for construction and operation.

The EIS shows that the activity in the disposal facility will not give rise to unacceptable damage and detriment for human health and the environment. This means that the siting at Forsmark satisfies the requirements of the Environmental Code.

G.3.3 Regulatory control

SSM reviews SKB's R&D programme and circulates it for comments to a number of concerned organisations (e.g. universities, government agencies, NGOs and municipalities that might host a spent nuclear fuel facility). When the review is completed the R&D programme together with SSM's recommendations are sent to the Government for its decision.

SSM have regular consultations with SKB regarding progress in the siting of the planned facilities.

SSM is consulted regarding the EIA. The concerned County Administrative Boards are also consulted regarding the EIA and thus exercise some regulatory control, however not in the fields of nuclear safety and radiation protection.

It should be emphasised that SKB:s decision to choose Forsmark as the location for a future spent fuel disposal facility is an internal SKB decision.

The selection of Forsmark will not be final until the Government approves SKB:s application in its entirety, i.e. both the choice of site and the chosen method to be implemented at the chosen site.

G.3.4 Conclusion

Sweden complies with the obligations of Article 6.

G.4 Article 7: DESIGN AND CONSTRUCTION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:
(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;
(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;
(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

G.4.1 Regulatory requirements

The general safety regulations SSMFS 2008:1, apply to the operation of all types of nuclear installations, including facilities for the treatment, storage and disposal of spent fuel and radioactive waste. The basic provisions regarding safety assessment and review and can be summarised in the following points.

G.4.1.1 measures to limit radiological impact

The requirements for limiting the possible radiological impact on individuals, society and the environment, including those from discharges or uncontrolled releases, are founded upon the basic provisions stipulated in 4§ first paragraph in the Act on Nuclear Activities (1984:3). This is clarified further in the revised general safety regulations (SSMFS 2008:1) in which it is stated that nuclear accidents shall be prevented through a basic facility-specific design that shall incorporate multiple barriers as well as a facility-specific defence-in-depth system.

Defence-in-depth shall be achieved by ensuring that:
- the design, construction, operation, monitoring and maintenance of a facility is such that abnormal events, incidents and accidents are prevented;
- multiple devices and measures exist to protect the integrity of the barriers and, if the integrity should be breached, to mitigate the ensuing consequences; and
- any release of radioactive substances, which may still occur as a result of abnormal events, incidents and accidents, is prevented or, if this is not possible, controlled and mitigated through devices and prepared measures.

G.4.1.2 Conceptual plans and provisions for decommissioning

The Act on Nuclear Activities states that the holder of a licence for nuclear activities is responsible for ensuring that all necessary measures are taken to ensure the

safe handling and disposal of nuclear waste, or nuclear material that is not reused, as well as the safe decommissioning and the dismantling of facilities.

Chapter 9 of the general regulations concerning safety in nuclear installations (SSMFS 2008:1) con- tains requirements on decommissioning plan and a specific operational safety assessment to be carried out as soon as a decision has been taken on final closure of a disposal facility.

The regulations on Planning before and during decommissioning of nuclear facilities (SSMFS 2008:19) comprises requirements for decommissioning with respect to documentation, alternative actions and waste management with regards to radiation protection (see section E.2.2.2).

G.4.1.3 Technology provisions for closure of repositories

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) stipulate that analy- ses of conditions that are of importance for the safety of a facility shall be carried out before a facility is constructed and taken into operation. This is further specified in the regulations concerning safety in connection with the disposal of nuclear material and nuclear waste (SSMFS 2008:21) where it is stipulated that for repositories, the safety assessments shall also comprise features, events and processes that can lead to the dispersion of radioactive substances after closure. Such safety analyses shall be made before the commencement of disposal facility construction, disposal facility operation and disposal facility closure.

G.4.1.4 Technology supported by experience

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) specify requirements regarding design and construction. It is stated that the design of the facility, with adaptation to the specific conditions of each facility, shall:

- be able to withstand component and system failures;
- have reliability and operational stability;
- be able to withstand such events or conditions which can affect the safety function of the barriers or defence-in-depth; and
- have maintainability, controllability and testability of inherent parts as long as these parts are used for their intended purposes.

Additional requirements related to design and construction are:

- The design principles and design solutions shall be tested under conditions corresponding to those that can occur during the intended application in a facility. If this is not possible or reasonable, they must have been subjected to the necessary testing or evaluation related to safety.
- The design solutions shall be adapted to the personnel's ability to manage the facility, in a safe manner, under normal conditions as well as during abnormal events, incidents and accidents that might occur.
- Building components, devices, components and systems shall be designed, manufactured, installed, controlled and tested in accordance with requirements that are adapted for their importance for safety.

G.4.2 Measures taken by the license holders

G.4.2.1 Suitable measures to limit radiological impact

The safety philosophy applied in the design of all Swedish nuclear facilities is based on the principles of defence-in-depth and of multiple barriers to prevent the release of radioactive material to the environment. They are all designed to fulfil the intention of the requirements in the General Design Criteria. The foundation of the safety principle on the defence in depth is emphasised and made clearer through the implementation of that principle in the general regulations SSMFS 2008:1.

G.4.2.2 Conceptual plans and provisions for decommissioning

Decommissioning studies have been developed by SKB, as part of the basis for the cost calculations (see section E.2.2.5). The final closure of Barsebäck 2 has caused the management of Barsebäck to initiate a more detailed study on the decommissioning of the site. A decommissioning plan for Barsebäck 1 and Barsebäck 2 has been submitted to, and approved of, by the regulatory authorities.

G.4.2.3 Technology supported by experience

General
The principle of proven technology is broadly accepted and implemented in the design and construction procedures for the Swedish nuclear facilities. The use of properly environmentally qualified equipment ensures functioning of safety-related systems and components under emergency conditions. A comprehensive programme for environmental qualification has been carried out.

Both the Canister laboratory and the Äspö laboratory have been used for several years in developing technologies for encapsulation and disposal of spent fuel. The experience from experiments and tests in these laboratories is and will be used when the encapsulation plant and the disposal facility for spent nuclear fuel are designed and constructed.

No major new steps are envisaged in addition to the previous programme, although research and development continues. In the modernisation work, the specification of all new installations is carefully checked with respect to environmental requirements.

Deliver Control Model for Technical development
Technology development for the encapsulation plant and the spent fuel disposal facility are carried out using the SKB delivery control model. This model has four different phases in where experience and testing gradually increases.

Concept phase: The purpose of the concept phase is to specify the requirements on the subsystem or the component, make a broad evaluation of conceivable solutions and propose one or more technical solutions to proceed with in the next phase. This entails that a reference design (or several alternative reference designs) is established for the subsystem, that it has been shown how this (these) reference design(s) can be verified against the design premises defined for the concept phase, and that a feasible way to production and an inspection programme has been found.

Design phase: The purpose of the design phase is to produce a design of the subsystem or component, to verify that it satisfies the requirements, and to formulate proposals for production, inspection and maintenance of the subsystem or component. The design phase may be iterative since it may turn out that the proposed solution does not satisfy the requirements, cannot be produced, or cannot be inspected in an efficient manner. As a rule, the design phase consists of two stages: initial system design and final detailed design.

Implementation phase: The purpose of the implementation phase is to build up production and inspection systems. This phase also includes the documentation, including any licensing, that is needed for operation of the subsystem or component. The goal of the implementation phase is that the system or component is run-in and ready to be handed over to operation.

Administration phase: The administration phase begins when the system or component has been put into operation. The goal of this phase is to make use of operating experience in a structured way as a basis for possible modifications of both the production apparatus and the product. If and when it is warranted, a change case or project is initiated.

Work methodology during construction

The construction of the encapsulation plant and the spent fuel disposal facility is divided into two processes

- Safety Assessment
- Construction

The processes with constituent components and interrelationships are illustrated in Figure G1. The activities aimed at producing an updated safety analysis report for an application for trial operation are gathered within the main process Safety Assessment. The starting point is the site description that was prepared after completed site investigation and the safety assessment SR-Site. Regular cross-checks and possible updatings will then be made with the guidance of information produced by the main process Construction as a result of, for example, the detailed characterization that is done. Safety evaluations may be needed, e.g. prior to a new construction stage, in order to check that the planned design and execution meet design premises with respect to long-term safety.

Conversely, Safety Assessment can provide guidance in the form of requirements and restrictions that must be complied with in order for construction to result in a safe disposal facility. All activities needed for the facility to be constructed are gathered within the main process “Construction”. Solid boxes in Figure G1 show the components included during the construction phase. The intention is to apply the same processes during the operating phase, with the addition of components indicated by dashed boxes in the figure. Activity during the construction phase consists of investigations including monitoring, modelling, design with predictions for construction, and production in the form of rock excavation, installation etc. Additional activities during the commissioning phase are facility documentation and organizational preparations for operation. The methodology for the main process Construction according to Figure G1 mainly applies to the hard rock facilities and consists of rock construction in accordance with the Observational Method.

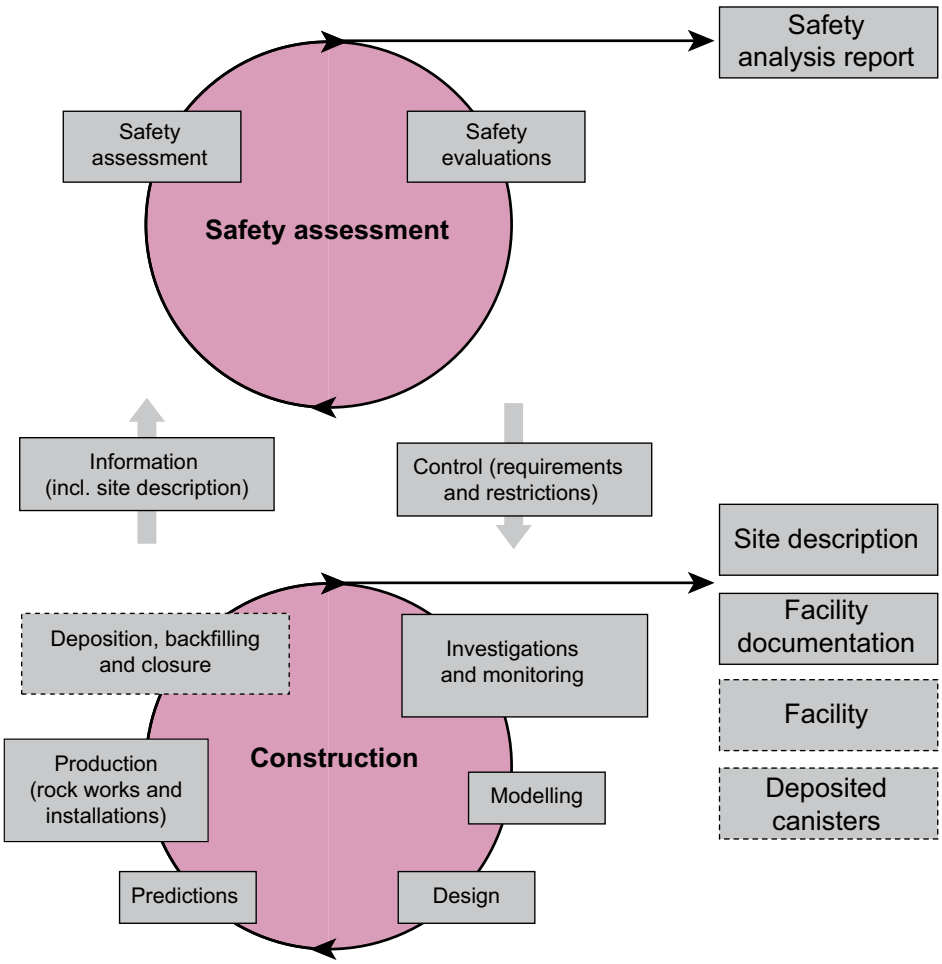


Figure G1: The main processes Safety Assessment and Construction, with constituent components, work flows and important relationships. Dashed components are added when the disposal facility is put into operation

This method is suitable because the exact rock conditions where the facility parts are to be built cannot be fully determined in advance. A tool is therefore needed to gather information from investigations and actual inspections as well as experience from the construction works. This information must then be interpreted so that it can be translated, via design and construction predictions, into adaptation of the construction technology or the design of the facilities. The purpose of the Observational Method is to systematize this iterative mode of working. This makes heavy demands on smoothly functioning information and work flows, but also on an ability to interpret and understand the information so that the right measures can be adopted. In daily application, this may mean for example that rock support and sealing measures can be planned with the support of the latest information obtained from the rock excavation works. In the longer term, the same principle is used for stepwise build-out of the facility, where the detailed planning of each stage is based on the latest information from investigations and experience from previous stages.

The mutual control between the main processes can also be handled to some extent within the application of the Observational Method. If the information warrants far-reaching changes that entail revisions of site descriptions and safety assessments, however, this must be handled at higher decision-making levels.

G.4.2.4 The application for the disposal facility for spent nuclear fuel

In March 2011 SKB applied for a permit to build a disposal facility for spent nuclear fuel and the encapsulation plant where the fuel will be encapsulated before being transported to the disposal facility. Construction of nuclear facilities require permits in accordance with the Swedish Environmental Code and the Act (1984:3) on Nuclear Activities. Both laws require that SKB reports the planned operations. The Act (1984:3) on Nuclear Activities states that this report must address radiation protection and short and long-term nuclear safety. The Environmental Code specifically requires a description of the potential impact of the planned operations on human beings and the environment. The Act (1984:3) on Nuclear Activities requires an equivalent impact assessment.

Structure

The motions for the application according to the Environmental Code are for the municipality in Oskarshamn to store nuclear fuel and nuclear waste up to 8000 tonnes in Clab and to in adjacent to Clab build and operate a plant for encapsulation of spent nuclear fuel up to 200 canisters per year.

For the municipality of Östhammar (Forsmark) the motions are to build and operate a facility for disposal for spent nuclear fuel and radioactive waste, all in accordance to the application. The motions for the application according to the Act (1984:3) on Nuclear Activities are in Forsmark to build, possess and operate a facility of disposal of spent nuclear fuel. In the facility possess, manage, transport, finally dispose of and in other aspects manage in one specified material, all in accordance with the application. Since, the motion of the applications are different the supporting documents contain parts that are identical and others parts that differs, se figure G2.

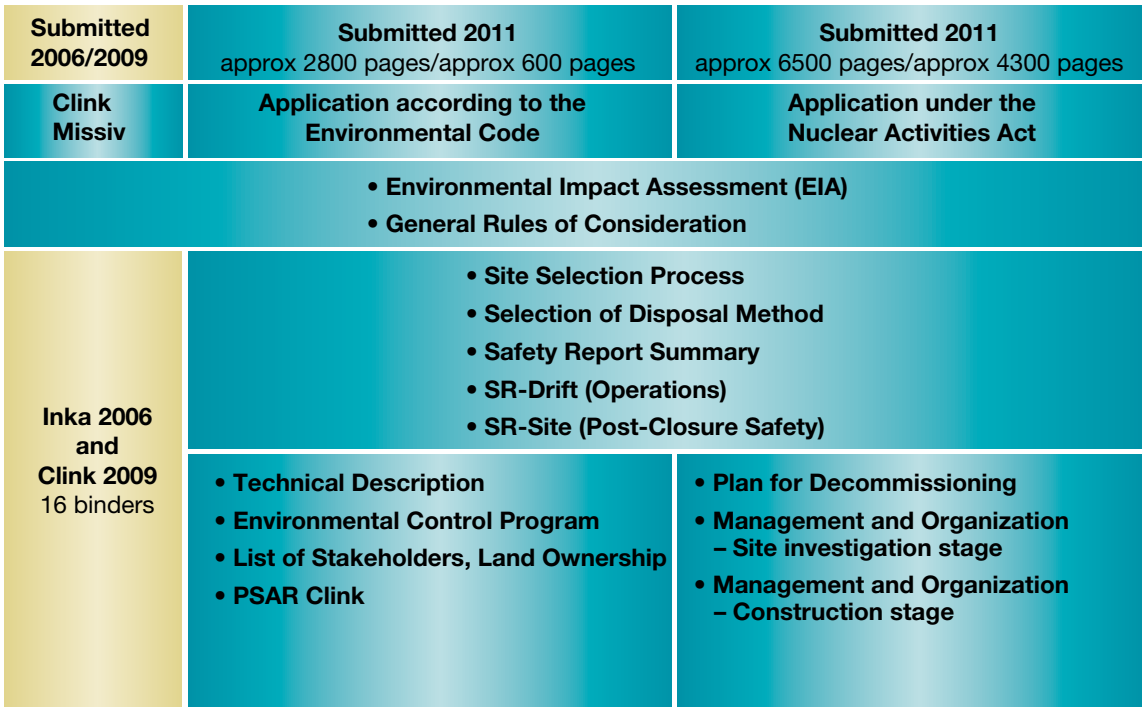


Figure G2: A presentation of the ingoing document for the license applications.

Environmental Code – Application Structure
The application consists of a top document. In which the case is summarized and the claims are accounted for. The top document is supported by eleven underlying documents wherein seven are the same as for the license application according to the Act (1984:3) on Nuclear Activities.

- Environmental Impact Assessment (EIA)
- General Rules for Consideration
- Site Selection Process
- Selection of Disposal Method
- Safety Report Summary
- SR-Drift (Operational safety)
- SR-Site (Post-Closure safety)
- Technical Description
- Environmental Control Program
- List of Stakeholders, Land Ownership
- Preliminary Safety Report (PSAR) for Clink

The Environmental Impact Assessment (EIS) and its purpose are described in more detail below. In short the EIS document constitutes the basis for the decision in the permit probation and contains a joint assessment of the affects of the KBS-3 system on human health and the environment

The General Rules of Consideration presents and motivates how SKB is going to meet the requirements of the general rules of requirements in accordance to the Environmental Code for Clab, the encapsulation plant, the disposal facility facility and the disposal facility of spent nuclear fuel.

The Site Selection Process document describes and motivates the site selection and is supported by an underlying report consisting of a comparative analysis of safety related site characteristics (Forsmark vs. Oskarshamn).

The Selection of Disposal Method document presents the background and SKB's motives for selecting the KBS-3 method for handling the disposal of spent nuclear fuel.

The Safety Report Summary is supported by two underlying documents;

- *The SR-Drift (Operational Safety)* document is a preliminary safety report which main purpose is to describe how SKB is planning to meet the requirements (Act (1984:3) on Nuclear Activities and Radiation Protection Act) for safety and radiation protection during operation in the facility for disposal of spent nuclear fuel.
- *The SR-Site (Post-Closure Safety)* document is a preliminary safety report which main purpose is to describe how SKB is planning to meet the requirements (Act (1984:3) on Nuclear Activities and Radiation Protection Act) regarding long-term safety and radiation protection for the disposal facility. The report is presented in more detail below.

The Technical Description describes the activities and facilities during construction and operation. In particularly the activities/facilities that will impact the environment. In the Environmental control program SKB presents the plan for surveillance and control of environmental unfriendly activities.

The List of Stakeholders, Land Ownership presents whom SKB believes are the stakeholders in the water-case* as well as confirm that SKB has the land ownership over the area of water within the real estates where SKB will conduct water activities.

The Preliminary Safety Report (PSAR) for Clink will clarify the structure of the integrated safety report for Clab and the encapsulation facility (Clink).

Act (1984:3) on Nuclear Activities – Application Structure
The application consists of a top document in which the case is summarized and the claims are accounted for. The top document is supported by ten underlying documents. The first seven documents listed below are the same as for the license application according to the Environmental Code, see explanation of the documents above.

- Environmental Impact Assessment (EIA)
- General Rules for Consideration
- Site Selection Process
- Selection of Disposal Method
- Safety Report Summary
- SR-Drift (Operational safety)
- SR-Site (Post-closure safety)
- Plan for Decommissioning
- Management and Organization – Site investigation stage
- Management and Organization – Construction stage

** In addition to requirements for licenses under the Act on Nuclear activities and the environmental Code, SKB:s activities must also be subject to licensing according to use of, or impact on, water resources.*

The Preliminary plan for Decommissioning document describes how SKB is planning to meet the requirements for decommissioning of the facility.

The Management and Organization – Site Investigation Stage document describes how SKB organised, managed and controlled the site investigations.

The Management and Organization – Construction Stage document it is described how SKB is planning to organise, manage and control the construction and operational phase of the disposal facility facility.

Structure of the EIS document

The Environmental Impact Assessment (EIA) is drawn up in consultation with authorities, municipalities, organisations, the general public and individuals who will be affected. The consultations regarding the disposal facility and the encapsulation facility for the spent nuclear fuel were initiated in 2002 and concluded in May 2010.

The Environmental Impact Statement (EIS) includes interim storage, encapsulation and disposal of spent nuclear fuel and the facilities that are planned for this purpose (Clab, encapsulation plant and disposal facility). SKB has developed an EIS that will be submitted with the applications according to both the Environmental Code and the Act (1984:3) on Nuclear Activities.

The EIS document describes the planned activities, the conditions on the sites in question and the implications and consequences that may occur to the environment and human health. Furthermore, measures to prevent, remedy or reduce the consequences that may arise are described.

The examination in accordance the Environmental Code should also consider the follow-on activities that are needed, such as transport to and from the plants and water activities. These are described in the EIS. Examples of activities that are not included in the EIS are mining of copper and iron for the manufacture of canisters, canister production and mining of bentonite. The EIS is structured according to below:

- Background
- Site features
- Clab (Interim storage facility for spent nuclear fuel)
- Clink (Clab and encapsulation plant as an integrated unit)
- Disposal facility for spent nuclear fuel
- Zero alternative
- Combined consequences of the entire system

The Background chapters describe the background, purpose and the method chosen for disposal of spent nuclear fuel and provide a description of possible alternative sites and alternative designs. Furthermore it describes how SKB has carried out the consultations under the Environmental Code.

Chapter Site features describe the conditions at the places where SKB is applying to locate the encapsulation plant and the disposal facility for spent nuclear fuel.

The Clab and Clink chapters describe facility design, activities and their impact and consequences on human beings and the environment as well as the alternative locations that were considered.

The chapter Disposal facility for spent nuclear fuel describe facility design,

activities and their impact and consequences on human beings and the environment, including the long-term safety and alternative locations.

The Zero alternative chapter describe the consequences if the activity or measures are not implemented, that is if the encapsulation plant and the disposal facility are not built.

The Combined consequences of the entire system chapter gives a comprehensive of the consequences and measures for the entire system for storage, encapsulation and disposal of spent nuclear fuel. It also compares the applied activities and locations with alternatives and with the zero alternative. The cumulative effects, due to existing and anticipated activities, are described for each site.

Structure of the long-term safety assessment (SR-Site)

The purpose of the licence application is to present all the material required to obtain a licence to build, operate and possess a disposal facility for spent nuclear fuel at Forsmark. The long-term safety assessment SR-Site forms a vital part of the licence application. The main purposes of the SR-Site are:

- To investigate whether the KBS-3 method has the potential of fulfilling regulatory safety criteria for long-term safety at the Forsmark site, with the host rock conditions emerging from the surface based site investigations;
- To provide feedback to design development, to SKB's R&D programme, to detailed site investigations and to future safety assessment projects.

The safety case is essentially documented in the main report of the safety assessment SR-Site and its supporting documents.

The SR-Can report (2006) was a preparation for SR-Site and had essentially the same structure. SR-Can was jointly reviewed by SKI and SSI (now merged to SSM) aided by three international review teams and additional external experts. The SR-Site project was initiated in April 2007 and the comments from the review of the SR-Can report were the basis for the continuing development of the report.

The structure and contents of SR-Site is adapted to regulatory requirements in

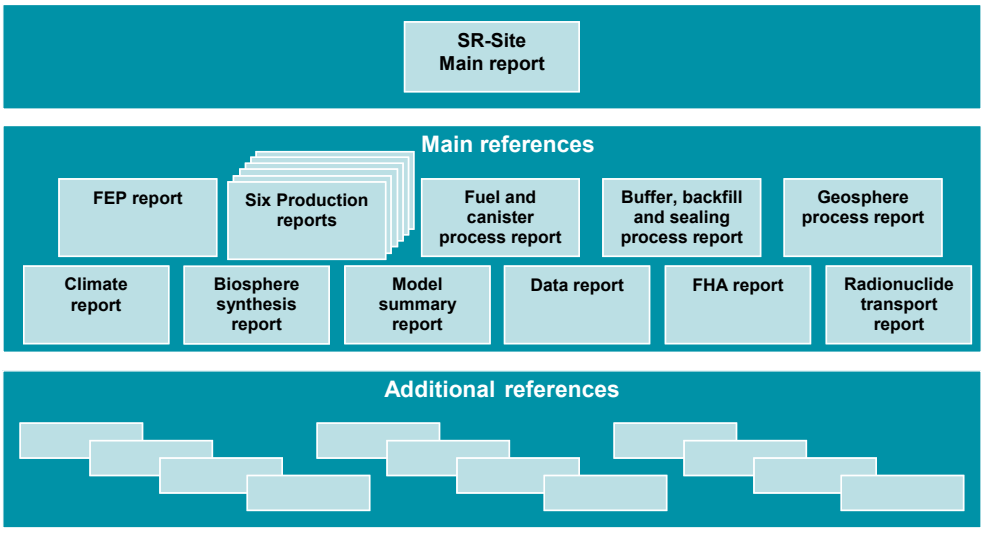


Figure G3: The structure of the SR-Site documentation.

Sweden. SR-Site and its supporting documents (see figure G3) cover the elements of a long-term safety assessment.

The SR-Site Main report consists of three volumes (total of about 1000 p.), 16 main references, and around 75 additional references produced within the project. Central references for SR-Site are also the Site Descriptive Model, Disposal Facility engineering and Layout reports.

The structure of SR-Site main report is consistent with the SR-Can report. However, there is a new chapter 14 concerning additional analyses. In this chapter, a number of additional analyses, required to complete the safety assessment, are carried out and presented. These comprise a sensitivity analyses of the outcome of the scenario analyses, analyses required to demonstrate optimisation and use of best available technique, verification that FEPs omitted in earlier parts of the assessment are negligible in light of the completed scenario and risk analysis, analyses supporting risk discussion for the initial 1,000 years, e.g. "what if"-cases to illustrate barrier functions during early times, a brief account of the time period beyond one million years, natural analogues, and analyses of additional cases to illustrate barrier functions.

Site selection

SKB selected the Forsmark site for a disposal facility for spent nuclear fuel in June 2009. The selection was based on evaluations of 5 years of surface based site investigations at Forsmark (municipality of Östhammar) and Laxemar (municipality of Oskarshamn) during 2002-2007, which were the final stage of 15 years of siting.

The site selection was made by SKB in order to focus the remaining work for the licence application that remains to be reviewed with the licence application. SKB analyses showed that Forsmark had clear advantages with respect to long-term safety; essentially a considerably lower frequency of water-conducting fractures at disposal facility depth.

The review process – Environmental Code and Nuclear Act

According to the Environmental Code facilities in a coherent system with the aim to store or dispose spent nuclear fuel or nuclear waste the hearings can be held in an Environmental Court where one of the planned or existing facilities are going to be situated or already are situated.

The applications will be submitted to the Environmental Court and to the Swedish Radiation Safety Authority.

The Environmental Court will prepare the case and review it according with the Environmental Code and they will hold a main hearing. They will then give a ruling to the Swedish Government. The Government gives an operation permissible which the municipalities of Östhammar and Oskarshamn will accept or reject. The municipalities have their veto. If accepted, the Environmental Court will hold a new hearing. Thereafter, the Court will grant permits and stipulate conditions pursuant to the Environmental Code.

The Swedish Radiation Safety Authority will prepare the case in accordance with the Act (1984:3) on Nuclear Activities and the Government will give a permit. The Government gives the permit to the Swedish Radiation Safety Authority that will stipulate the conditions.

G.4.3 Regulatory control

During the licensing process the PSAR, SAR and OLC documents are reviewed by the regulatory authority, to ensure compliance with fundamental safety principles and criteria. A prerequisite for obtaining a licence is that the regulatory review concludes that the facility is designed according to the provisions in the general regulations (SSM 2008:1).

G.4.4 Conclusion

Sweden complies with the obligations of Article 7.

G.5 Article 8: ASSESSMENT OF SAFETY OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:
(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;
(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

G.5.1 Regulatory requirements

G.5.1.1 Assessment of safety

Requirements on safety assessment, safety review and reporting are listed in the revised general safety regulations (SSMFS 2008:1). Many of these requirements are not new but were posed earlier as licensing conditions for facilities licensed before the regulations came into force. Some of the requirements are, however, more comprehensive compared to earlier conditions, and some are new. The legally binding requirements regarding safety assessments are summarised in the following points:

- A comprehensive safety analysis shall be performed before a facility is constructed and before it is taken into operation. The analysis shall subsequently be kept up-to-date. The analysis shall be based on a systematic inventory of events, event sequences and conditions, which can lead to a radiological accident.
- A preliminary safety report shall be prepared before a facility may be constructed. The safety report shall be updated before trial operation of the facility may be started. The safety reports shall contain information as specified in the regulations The safety report shall be supplemented before the facility is taken into routine operation. The safety report shall subsequently be kept up-to-date. The safety reports shall be reviewed, evaluated and approved by the regulatory authority as required.

The general safety regulations SSMFS 2008:1, apply to the operation of all types of nuclear installations, including facilities for treatment, storage and disposal of spent fuel and radioactive waste. The basic provisions regarding safety assessment and review and can be summarised in the following points:

Safety Analysis
Analyses of conditions that are of importance for the safety of a facility shall be carried out before a facility is constructed and taken into operation. The analyses shall subsequently be kept up-to-date. The safety analyses shall be based on a systematic inventory of such events, event sequences and conditions that could lead to a radiological accident.

Safety Report
A preliminary safety report shall be prepared before a facility may be constructed. The safety report shall be updated before trial operation of the facility may be started. The safety report shall be supplemented before the facility is taken into routine operation. The safety report shall subsequently be kept up-to-date. The content of the safety report is specified in the regulations. Before the facility may be constructed and taken into operation, the safety report shall be evaluated and approved by SSM. The safety report shall subsequently be kept up-to-date. In the updating of the regulations it has been clarified that the safety report (SAR) shall reflect the plant as built, analysed and verified and show how the valid safety requirements are met. Plant modifications shall be assessed against conditions described in the SAR. It has further been clarified that all plant structures, systems and components of importance for the defence-in-depth shall be described in the SAR, not only the safety systems. New safety standards and practices, which have been assessed by the licensee and found applicable, shall be documented and inserted into the SAR as soon as corresponding modifications or other plant measures have been taken. A few additional requirements on the contents of the SAR have also been added.

Safety Review
A safety review shall determine or check that the applicable safety related aspects of a specific issue have been taken into account and that SSMFS 2008:1 appropriate safety-related requirements with respect to the design, function, organisation and activities of a facility are met. The review shall be carried out systematically and shall be documented. A safety review shall be performed within those parts of the organisation responsible for the specific issues (”primary review”). A second safety review shall be performed by a safety review function appointed for this purpose and that has an independent position relative those parts of the organisation responsible for the specific issues (”secondary review”).

Safety Programme
After it is taken into operation, the safety of a facility shall be continuously analysed and assessed in a systematic manner. Any need for improvement regarding safety measures, engineering or organisational issues, which arise as a result of such analyses and assessments, shall be documented in a safety programme. The safety programme shall be updated on an annual basis.

Periodic Safety Review of Facilities
At least once every ten years, a new, integrated analysis and assessment of the safety of a facility shall be performed. The analyses and assessments, as well as the measures proposed on the basis of these shall be documented and submitted to SSM. In the most recent update of the general regulations, the requirements on Periodic Safety Review (PSR) have been made more stringent in order to use

these reviews for assessment of time limited licensing conditions. This means that the Swedish approach to PSR becomes more in line with the European approach, where PSR is often used in the re-licensing of the nuclear power facilities.

Modifications
A safety review shall be performed for engineering or organisational modifications to a facility, which can affect the conditions specified in the safety report as well as essential modifications to the report. Before the modifications may be included in the report, SSM shall be notified and the Inspectorate can decide that additional or other requirements or conditions shall apply with respect to the modifications.

Post Closure Safety
Additional requirements concerning the long-term safety of a disposal facility are stipulated in the regulations concerning safety in connection with he disposal of nuclear material and nuclear waste (SSMFS 2008:21) as well as Regulations and General Advice on the Protection of Human Health and the Environment in connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste (SSMFS 2008:37). According to the regulations, the safety assessment for a disposal facility shall also comprise features, events and processes that can lead to the dispersion of radioactive substances after closure. Such safety assessments shall be made before disposal facility construction, before operation and before closure. The safety assessment shall cover as long a time as barrier functions are required, but at least ten thousand years.

G.5.1.2 Environmental assessment

The Act on Nuclear activities also states that an EIA (Environmental Impact Assessment) shall be made in all licensing cases, and that the Environmental Code regulates the way the EIA shall be carried out as well as the contents of the documentation. Requirements on environmental assessment are laid down in the Environmental Code (1998:808) as described in Section E.2.2.4. The purpose of an EIA is to establish and describe the direct and indirect impacts of a planned activity or measure as listed below.
An environmental impact statement shall contain the following information:

- a description of the activity or measure with details of its location, design and scope;
- a description of the measures being planned with a view to avoiding, mitigating or remedying adverse effects, for example action to prevent the activity or measure leading to an infringement of an environmental quality standard;
- the information that is needed to establish and assess the major impact on human health, the environment and the management of land, water and other resources that the activity or measure is likely to have;
- a description of possible alternative sites and alternative designs, together with a statement of the reasons why a specific alternative was chosen as well as a description of the consequences if the activity or measure is not implemented; and
- a non-technical summary of the information.

G.5.1.3 The licensing procedure

Three different permits/licences are required for a nuclear facility: a permit under the Environmental Code (1998:808) a licence under the Act (1984:3) on Nuclear Activities (1984:3), and a building permit under the Planning and Building Act (2010:900). Licensing under the Environmental Code and the Act on Nuclear

Activities occur in parallel. The applications under both laws must include an environmental impact statement (EIS) prepared according to the rules in Chapter 6 of the Environmental Code. The same EIS is thus used in both applications. Separate EISs are prepared for the encapsulation plant and the disposal facility for spent nuclear fuel.

According to Chapter 17 of the Environmental Code, the Government shall, after preparation by the Environmental Court, examine the permissibility of the activity. After SSM's preparation of the matter, the Government shall also examine permit applications under the Act on Nuclear Activities. If the Government finds that the construction and operation of the facility is permissible according to the Environmental Code and grants a permit/licence under the Act (1984:3) on Nuclear Activities, it remains for the Environmental Court to grant a permit/licence and stipulate conditions in accordance with the Environmental Code.

G.5.2 Measures taken by the license holders

General
In March 2011 SKB applied for the permits needed for the disposal facility for spent nuclear fuel in accordance with the Swedish Act on Nuclear Activities. The SR-Site report is a main component in SKB's licence application to construct and operate a disposal facility for spent nuclear fuel at Forsmark. Its role in the application is to demonstrate long-term safety for the disposal facility.

Purpose
The main purposes of the safety assessment project SR-Site are:

- To assess the safety, as defined in applicable Swedish regulations, of the proposed KBS-3 disposal facility at Forsmark.
- To provide feedback to design development, to SKB's RD&D-programme, to detailed site investigations and to future safety assessment projects.

An important step leading up to the present report was the preparation of the SR-Can safety assessment report, published in November 2006. The SR-Can report was reviewed by the Swedish safety authorities aided by a group of international experts, and the outcome of the review has been taken into account in the SR-Site assessment.

Summary of results
The central conclusion of the safety assessment SR-Site is that a KBS-3 disposal facility that fulfils long-term safety requirements can be built at the Forsmark site. This conclusion is reached because the favourable properties of the Forsmark site ensure the required long-term durability of the barriers of the KBS-3 disposal

facility. In particular, the copper canisters with their cast iron inserts have been demonstrated to provide a sufficient resistance to the mechanical and chemical loads to which they may be subjected in the disposal facility environment.

The conclusion is underpinned by:

- The reliance of the KBS-3 disposal facility on i) a geological environment that exhibits long-term stability with respect to properties of importance for long-term safety, i.e. mechanical stability, low groundwater flow rates at disposal facility depth and the absence of high concentrations of detrimental components in the groundwater, and ii) the choice of naturally occurring materials (copper and bentonite clay) for the engineered barriers that are sufficiently durable in the disposal facility environment to provide the barrier longevity required for safety.
- The understanding, through decades of research at SKB and in international collaboration, of the phenomena that affect long-term safety, resulting in a mature knowledge base for the safety assessment.
- The understanding of the characteristics of the site through several years of surface-based investigations of the conditions at depth and of scientific interpretation of the data emerging from the investigations, resulting in a mature model of the site, adequate for use in the safety assessment.
- The detailed specifications of the engineered parts of the disposal facility and the demonstration of how components fulfilling the specifications are to be produced in a quality assured manner, thereby providing a quality assured initial state for the safety assessment.

The detailed analyses demonstrate that canister failures in a one million year perspective are rare. Even with a number of pessimistic assumptions regarding detrimental phenomena affecting the buffer and the canister, they would be sufficiently rare that their cautiously modeled

Future development of the disposal facility programme

The design and safety evaluation of a disposal facility concept for geological disposal like the KBS-3 system is developed in steps, where a safety evaluation in one step provides feedback to the development of the disposal facility design. The developed design is then evaluated in a subsequent safety assessment, which provides refined feedback to the further development of the design, etc. Likewise, the understanding of natural processes of importance to long-term safety is developed in a R&D programme and the emerging findings are evaluated in an iterative interaction with safety assessment projects. Another important aspect of this iterative nature of the development is the external reviewing, by authorities and international experts, of the safety assessments.

SKB has conducted research and development of the KBS-3 system for three decades and both the disposal facility design and the scientific knowledge is mature, as manifested by the facts that no major design changes have occurred in recent years and that the identified set of processes of importance for long-term safety is stable, as is the knowledge about the processes.

SKB has established a technically feasible reference design and layout of the KBS-3 disposal facility and showed that this conforms to the established design premises, see below, but technical development will continue. Detailed designs

adapted to an industrialised process designed to fulfil specific requirements on quality, cost and efficiency need still be developed. The layout needs to be adapted to the local conditions found when constructing the disposal facility at depth. These, potentially more optimal solutions, should result in at least the same level of safety as the current reference design being assessed in SR-Site. Since SR-Site is an important basis for a critical decision point in the disposal facility programme, it is essential to demonstrate i) that the essential safety related features of the design are mature and ii) that there is at least one available and adequate option for parts of the system that are more peripheral in terms of contributing to safety.

Another characteristic of the present situation is that the well-established parts of the design are specified in detail; the feedback to design development from the safety assessment preceding SR-Site (the SR-Can assessment) is given in the form of detailed design premises, that have served as input to specifications of the reference design and facilitated the evaluation of the appropriateness of the design with respect to long-term safety.

Measures taken for environmental impact statement (EIS) are described in section H.3.2.

G.5.3 Regulatory control

The safety case as a basis for licensing and nuclear supervision.
The safety level to be attained and maintained by the licensee of a nuclear facility is defined in the licensing process.

The licence to build, possess and operate the facility is granted by the Government. This government licensing decision is applied for and granted early in the design process. These licence conditions requires that a preliminary safety report (PSAR) be submitted and approved by the regulatory body before major construction activities are started. A renewed safety report (SAR) and operational limits and conditions (OLC) should also be submitted and approved by the regulatory body before trial operation commences and a supplemented SAR should be submitted and approved by the regulatory body before routine operation commences . For a disposal facility, the safety assessment should comprise features, events and processes that can lead to the dispersion of radioactive substances after closure, as described in section H.5.1.1. Such a safety assessment shall be made before disposal facility construction, and before operation and before closure.

The PSAR, SAR and OLC documents are reviewed by the regulatory authorities, to ensure compli- ance with fundamental safety principles and criteria. Based on this licensing procedure, and on approval by the regulatory authorities, the SAR and OLC documents becomes the legally binding documents regulating technical configuration and operating limits and conditions, often referred to as ”the safety case”. This ”safety case” may be regarded as defining the minimum safety level that the licensee is legally committed to maintain as a condition for a permit to operate the facility. Hence, the safety case also provides the basis for regulatory supervision.

Additional licence conditions can be prescribed by the regulatory authority over time, based on national and international operating experience and new research results.

Preliminary long term safety analysis for a spent fuel disposal facility (SR-Can)
The regulatory authorities reviewed the SKB safety assessment SR-Can. This review is considered as part of the then ongoing consultations between SKB and the regulators, with the objective of providing guidance to SKB about expectations on the long term safety report (SR-Site) that SKB is to submit as support for the license application for a spent nuclear fuel disposal facility.

It should be noted that site suitability issues, formal compliance evaluation or other issues linked to the consideration of a license have not been addressed in this review. The authorities' review is mainly based on peer reviews by international experts organised within three groups focussing on safety as- sessment methodology, the representation of the engineered barrier system in the safety assessment, and the handling of site specific information, respectively.

Moreover, independent modeling activities, detailed expert reviews as well as a review of quality assurance issues provided additional input to the authorities' review. The main findings of the review are:

- SKB's safety assessment methodology is overall in accordance with applicable regulations, but part of the methodology needs to be further developed for the licence application.
- SKB's quality assurance of SR-Can is not sufficient for a licence application.
- The knowledge base needs to be strengthened for a few critical processes, such as buffer erosion, with potentially large impact on the calculated risk
- The link between assumed initial properties of disposal facility components and quality routines of manufacturing, testing and operation need to be strengthened before the licence application.
- There is a need for a more elaborate reporting on the potential for early releases from the disposal facility.

G.5.4 Conclusion

Sweden complies with the obligations of Article 8

G.6 Article 9: OPERATION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;

(v) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vi) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

G.6.1 Regulatory requirements

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) contain legally binding requirements relevant for all the obligations of Article 16. These requirements are summarised below.

G.6.1.1 Initial authorisation

As mentioned in section H.5, a preliminary comprehensive safety report is required before the construction of a spent nuclear facility. A complete safety report, which also takes into account the results from commissioning tests, is required before the facility is taken into operation.

G.6.1.2 Operational limits and conditions(OLC's)

Documented up-to-date Operational Limits and Conditions (OLCs) are required

containing the necessary operational limits and conditions, as further specified in a separate appendix to the regulations. The OLCs shall together with the operating procedures ensure that the conditions postulated in the safety re- port are maintained during the operation of the facility. The OLC's shall be subjected to a twofold safety review by the licensee and submitted to the regulatory authority for approval. The licensee shall notify regulatory authority about any changes, after they have been subjected to a two-fold safety review.

G.6.1.3 Established procedures

Suitable, verified and documented procedures are required for all operational states including accidents. The procedures for operability verification and procedures used in other operational states than normal operation shall be subjected to a twofold safety review by the licensee. Procedures for maintenance important for safety are also covered by the requirement. Maintenance programmes shall be documented. Inspection and testing of mechanical components shall be carried out according to qualified methods and verified procedures.

G.6.1.4 Engineering and technical support

The licensee shall ensure that adequate personnel is available with the necessary competence and suitability needed for those tasks which are important for safety, and also ensure that this is documented. A long-term staffing plan is required. The use of contractors as opposed to own personnel should be carefully considered in order to develop and maintain adequate in-house competence. The necessary competence should always exist in-house for ordering, managing and evaluating the results of work carried out by contractors of importance for safety.

G.6.1.5 Reporting of incidents in a timely manner

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) contains one chapter about reporting requirements and an annex specifying these requirements for various types of events. The following is a brief summary:

- Reporting without delay: emergency alarm events and events and conditions in category 1 (see below).
- Reporting within 16 hours: INES events at level 2 or higher.
- Reporting within 7 days: a comprehensive investigation report about alarm events or events and conditions in category 1.
- Reporting within 30 days: a comprehensive investigation report of events and conditions in category 2.

In addition, there are requirements on daily reporting of the operational state, and the occurrence of any abnormal events or disturbances, and requirements on a comprehensive annual report summarising all experience important for the safety of the plant. Specifications are given about the contents of the different reports and further interpretation of the reporting requirements is given in the general recommendations.

In one of the basic paragraphs of SSMFS 2008:1, requirements are given on

actions to be taken by the licen- see in cases of deficiencies in barriers or in the defence-in-depth system. These actions include first assessment, adjustment of the operational state, implementation of necessary measures, performance of safety reviews and reporting to SSM. A graded approach is allowed here.

In appendix 1 of the regulations, events and conditions are specified which require different responses, depending on the category of events they belong to. Three categories are defined:

Category 1
Severe deficiency observed in one or more barriers or in the defence-in-depth system, as well as a founded suspicion that safety is severely threatened. (In these cases the facility must be brought to a safe state without delay).

Category 2
Deficiency observed in one barrier or in the defence-in-depth system, which is less severe than that which is referred to in category 1, as well as a founded suspicion that safety is threatened. (In these cases the facility is allowed to continue operation under certain limitations and controls).

Category 3
Temporary deficiency in the defence-in-depth system, which arises when such an event or condition is corrected and which, without measures could lead to a more severe condition, and which is documented in the Technical Specifications. In all three cases, corrective measures shall be subject to a twofold safety review by the licensee. The results of these reviews shall be submitted to SSM. Regarding category 3 events, there is no requirement to make a specific report to SSM. It is sufficient to make a compilation of these events in the annual report.

G.6.1.6 Programmes to collect and analyse operating experience

The licensee shall ensure that experience from its own facilities and from similar activities in other relevant facilities is continuously analysed, used and communicated to the personnel concerned (SSMFS 2008:1). It is further required that all events and conditions which are detected and which are important to safety are investigated in a systematic manner, in order to determine sequences and causes, as well as to establish the measures needed in order to restore the safety margins and to prevent recurrence.

The results of the investigations shall be disseminated within the organisation and shall contribute to the development of safety at the facility. In accordance with SSMFS 2008:1 it is the responsibility of the licensee, as long as the disposal facility is in operation, to continuously keep informed of the conditions of importance to the assessment of disposal facility safety, also after closure.

G.6.1.7 Decommissioning plans

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) a chapter on decommissioning has been added with requirements on:

- A preliminary plan for the future decommissioning of the facility to be compiled as before construction of a facility.
- The decommissioning plan to be supplemented and incorporated into the facility's safety report before the dismantling of the facility may be initiated

- A decommissioning plan and a specific operational safety assessment to be done as soon as a decision has been taken on final closure of a facility.

The plan should include measures, which must be implemented to ensure the safe containment of the generated nuclear waste.

G.6.2 Measures taken by the license holders

The general safety regulations (SSMFS 2008:1) contain legally binding requirements relevant for all obligations of Article 9. These requirements are summarized below.

G.6.2.1 Initial authorisation

No spent nuclear facility has been commissioned since 1985 when the central interim storage for spent fuel (Clab) was taken into operation. The application procedure for the extension works to increase the storage capacity from 5 000 to 8 000 tons of uranium, was the first time the modernized legislative and regulatory system was implemented.

Although neither the Environmental Code, the SSM regulations 2008:1 and 2008:21, nor the Radiation Protection Act had been issued at the time for the application, the formal procedure to initiate the project was run according to procedures later established by the issuance of those documents, as described in sections E.2 (Legislative and regulatory framework), E.3 (Regulatory Body) and G.3 (Siting of proposed facilities).

The siting processes for the encapsulation plant, and the disposal facility for spent nuclear fuel, were initiated in accordance with the procedures outlined in this document. The procedure is described in detail in section G.3.2.

G.6.2.2 Operational limits and conditions(OLC's)

The operational limits and conditions for nuclear facilities are described in the operational limits and conditions (OLC), a document, which is considered to be one of the cornerstones in the governing and regulation of the operation of the Swedish nuclear activities. Every OLC is facility-specific and is approved by SSM as part of the licensing conditions.

The original OLC for each facility is derived from the safety analyses in the SAR, in which the behavior of the facility is described. Correction and updating takes place, when new and better knowledge is available, either from research, tests or operational experience. Suggestions for changes in OLC are reviewed carefully from the safety point of view at different levels in the operating organization and are finally approved by the regulatory body, before they are included in the document.

The fact that OLC is reviewed and revised regularly has contributed to making it a living document. It is also part of the quality and management system and used frequently in particular by the operations staff. An essential part of OLC is the general clause that says that "...should any doubt appear about the interpretation of the text, the general purpose of OLC shall be guiding. This means that the facility in all indefinite situations shall be maintained or brought respectively to a safe state." Other parts of OLC are the descriptive background to the document. The background description is important for preserving and transferred to new staff the knowledge and experience of those who participated in the original production of

OLC. Modified and maintained equipment must pass an operability test, to verify that the equipment fulfills specified operational requirements before being accepted for continuous operation.

G.6.2.3 Established procedures

All activities that directly affect the operation of the facility are governed by procedures of different kinds covering normal operation, emergency operation and functional tests. Maintenance activities according to an approved maintenance programme are also to a great extent accomplished according to procedures, however, not always as detailed as the operating procedures, in which activities are described in sequences step by step. Signing off the completion of steps carried out in the procedures is mandatory in most cases, in order to confirm the completion and facilitate verification.

The development of procedures follows specified directives, which include the reviewing of the documents, normally, by more than one person other than the author, before being approved by the operations manager or someone else at the corresponding level. The same applies for revising procedures. Revising procedures is to be carried out continuously, in particular maintenance procedures, when new experience is obtained. Emergency procedures have been developed in order to deal with anticipated operational events.

G.6.2.4 Engineering and technical support

The principles for staffing are reported in section F.2 (Human and financial resources).
Competence that might not be completely available within the own organisation at all plants is for instance expertise and resources for materials and chemistry assessments, radiation shielding and environmental consequence calculations, expertise and resources for software for safety applications and also process control and measurement techniques. In particular the IT functions have normally been outsourced, but are still available on-site. The intention is always to have the ordering competence within the operating organisation, and the capability of evaluating the results of analyses, calculations, etc. performed by consultants.

G.6.2.5 Reporting of incidents in a timely manner

Incidents significant to safety are reported according to the non-routine reporting requirements in the technical specifications (see section G.6.1.5) Two types of licensee event reports (LER) exist. The more severe one, called abnormal event, requires the facility to inform SSM within an hour. A final report shall be submitted within ten days from the time of the event and the analysis of the event and appropriate measures to prevent recurrence shall be approved by SSM. Only a very limited number of events of this category have occurred at the Swedish facilities over the years. These events are typically also of such a dignity as to warrant reporting in accordance with the International Nuclear Event Scale (INES).

The other type of LER, called RO (Reportable Occurrence), is used for less severe events. This type of event is mentioned in the daily report, which is sent to the regulatory bodies, followed up by a preliminary report within seven days and

a final report within 30 days. The reports are reviewed at different levels within the operating organization and approved by the operations or production manager before submittal.

The front of the standardized report form describes the event in general: identification number, title, reference to OLC, date of discovery and length of time until corrective actions were completed, conditions at the time of occurrence, system consequences, a contact person at the plant and activities affected by the event.
On the reverse side of the document a description of the event is given. The following titles are used:

- event course and operational consequence;
- safety significance;
- direct and root causes;
- planned/decided measures; and
- lessons learned by the event

If the description of the event is extensive additional pages may be attached to the form. Reports are also required in accordance with OLC when the permitted levels of activity release from the facility are exceeded, or in the event of unusually high radiation exposure to individuals. These types of non-routine reporting are primarily directed towards SSM.

G.6.2.6 Programmes to collect and analyse operating experience

The objective of the analysis and feedback programme concerning operating experience is to learn from their own and others' experience and thus prevent recurrences of events, particularly those that might affect the safety of the facility. The operating experience feed-back process consists of a wide variety of activities within the plant organization as well as externally.

G.6.2.7 Decommissioning plans

Decommissioning of a nuclear facility shall be described in a plan in which the degree of detail in the account increases as the time for decommissioning approaches. A preliminary decommissioning plan shall be supplemented and kept up-to-date as long as the facility is in operation and shall be presented to SSM every ten years. The preliminary decommissioning plans contains, among other things, a facility description, a plan for the decommissioning activities, plans for management and disposal of radioactive waste and cost estimates. Before dismantling operation may commence, the decommissioning plan must be incorporated in the safety analysis report for the facility.

All licensees for the for the Swedish NPP`s , with the exception of Barsebäck, are in the process of updating their decommissioning plans. An overall decommissioning plan for the units in Barsebäck has been submitted to, and approved of, by the regulatory authorities. A revised version is under way and is planned to be submitted during 2012.
SKB is the licensee for Clab and will likewise be the licensee for the integrated facility called Clink when the addition containing the planned encapsulation plant is finished. The decommissioning plan for Clink is preliminary and conforms to the

requirements made by the regulatory authorities on SKB for the coming licensing of the addition containing the encapsulation plant.
A preliminary decommissioning plan has been prepared for the Spent Fuel Disposal facility and will be included in the applications under the Act (1984:3) on Nuclear Activities for disposal of spent nuclear fuel and under the Environmental Code for the KBS-3 system.

G.6.3 Regulatory control

G.6.3.1 Initial authorisation

The regulatory control is achieved through the procedures described in sections E.2.3.1 (Licensing) and E.2.3.3 (Institutional control, regulatory inspection and reporting).

G.6.3.2 Operational limits and conditions

SSM reviews applications for changes in OLC, and for exemptions from OLC. Based on the application and information provided by the licensees, and the associated safety analyses, assessments are made about how the proposed changes or exemptions contribute to the risk profile of the facility.

G.6.3.3 Procedures

Operational and maintenance procedures are normally not reviewed by SSM. Only in connection with event investigations would SSM ask for a procedure to be submitted for review. In the frame of quality assurance inspections or review of quality audits made by the licensees (see section F.3) have SSM looked into the routines used for updating procedures.

G.6.3.4 Engineering and technical support

SSM has not so far specifically inspected the engineering and technical support available at the facilities. In connection with other inspections and reviews, the staffing situation has occasionally been commented upon.

G.6.3.5 Incident reporting

Licensee event reports are reviewed upon arrival by the responsible site inspector, who asks the facility for clarification if necessary. As a routine all LERs are screened once a week by a standing group of inspectors and specialists in order to assess the event, the analysis and the measures taken by the licensees. If there has been any regulatory concerns the issue is brought up at a management meeting and a decision made about any further measures to be taken by SSM.

G.6.3.6 Experience feedback analysis

The regulatory control is achieved through the procedures described in section E.2.3.3 (Institutional control, regulatory inspection and reporting). The experience feed back programme is followed- up by the regulator in connection with event investigations and in connection with other inspections and reviews.

G.6.3.7 Decommissioning plans

The decommissioning plans (see section H.6.1.8) must be submitted to SSM for approval before the decommissioning and dismantling activities may be started.

G.6.4 Conclusion

Sweden complies with the obligations of Article 9.

G.7 Article 10: DISPOSAL OF SPENT FUEL

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.

G.7.1 Regulatory requirements

According to the Act on Nuclear Activities the following definitions apply:

- spent nuclear fuel which has not been disposed of in a disposal facility is defined as nuclear material; and
- spent nuclear fuel which has been disposed of in a disposal facility is defined as nuclear waste.

Reprocessing is not part of the back end of the nuclear fuel cycle in Sweden, as described in section C, and the policy and practices for management of spent nuclear fuel is direct disposal, as described in section B.

It is also clearly stated in the general obligations in the Act on Nuclear Activities (10 §) that the holder of a licence for nuclear activities shall be responsible for ensuring that all measures are taken needed for:

- maintaining safety, with reference to the nature of the activities and the manner in which they are conducted; and
- ensuring the safe handling and disposal of nuclear waste arising from the activities or nuclear material arising therein that is not reused.

G.7.2 Measures taken by the license holders

The practical implication is that spent fuel is in practice treated as high level radioactive waste.

G.7.3 Conclusion

Sweden complies with the obligations of Article 10.

H.1 Article 11: GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, soc ety and the environment are adequately protected against radiolog cal and other hazards. In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;
(ii) ensure that the generation of radioactive waste is kept to the minimum practicable;
(iii) take into account interdependencies among the different steps in radioactive waste management;
(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;
(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;
(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;
(viii) aim to avoid imposing undue burdens on future generations.

Summary of developments since the last national report

- SKB submitted in January 2011 the most recent cost calculations under the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities. SSM will send a proposal on the size of fees and guarantees for the nuclear power plant licensees to the Government in October 2011.
- SKB submitted in September 2010 the RD&D-programme 2007. The regulatory authority has evaluated the program and submitted a statement to the Government.

H.1.1 Regulatory requirements

H.1.1.1 The general obligations of license-holders

As accounted for in section E.2.2.1, the Act (1984:3) on Nuclear Activities (1984:3) requires that the holder of a licence for the operation of a nuclear power reactor shall – in co-operation with the other holders of a licence for the operation of nuclear power reactors – establish and carry out an R&D-programme for the safe handling and disposal of spent fuel and nuclear waste. Every third year the

programme shall be submitted to the Government, or an authority assigned by the Government, for evaluation.

Also, as accounted for in section E.2.2.5, the Financing Act (2006:647) requires the licensees to submit, every three years, estimates of all future costs for management and disposal of spent nuclear fuel and nuclear waste, and decommissioning. The licensee of a nuclear power reactor shall base costs estimates on 40 years of operation with a minimum remaining operating time of 6 years. The licensee of nuclear facilities other than nuclear power reactors shall base cost estimates and the buildup of adequate financial resources on the expected remaining period of operation.

H.1.1.2 Basic provisions and license obligations

Basic safety provisions are stipulated in the Act on Nuclear Activities (1984:3). The requirements are further clarified in the general safety regulations SSMFS 2008:1. In the regulations it is stated that, in order to ensure adequate protection at all stages of spent fuel management, the licensee shall:

1. establish documented guidelines for how safety shall be maintained at the facility as well as ensure that the personnel performing duties which are important to safety are well acquainted with the guidelines;
2. ensure that the activities carried out at the facility are controlled and developed with the support of a quality system which covers those activities which are of importance for safety;
3. ensure that decisions on safety-related issues are preceded by adequate investigation and consultation so that the issues are comprehensively examined;
4. ensure that adequate personnel is available with the necessary competence and suitability on all respects needed for those tasks which are of importance for safety as well as ensure that this is documented;
5. ensure that responsibilities and authority are defined and documented with respect to personnel carrying out work which is important to safety;
6. ensure that the personnel is provided with the necessary conditions to work in a safe manner;
7. ensure that experience from the facility's own and from similar activities is continuously utilised and communicated to the personnel concerned; and
8. ensure that safety, through these and other measures, is maintained and continuously developed.

In the Radiation Protection Act (1988:220) it is stipulated that radioactive waste shall be handled and disposed of in a manner that is satisfactory from a radiation protection point of view. More detailed requirements on the handling of radioactive waste and nuclear waste at nuclear facilities are stipulated in SSMFS 2008:22. The regulations put requirements on waste management plans and registration of waste and reporting to the SSM. At the facility a register shall be kept over waste that without further treatment is to be transferred to disposal in Sweden or is intended to be temporarily stored for more than two years. The register shall be subdivided into items such as packages, components, containers or other units corresponding to the handling of the waste.

For each item the register shall contain information on:
1. identity;
2. the origin of the waste or what part or parts of the facility it comes from;
3. the treatment of the waste and its physical and chemical form;
4. the amount of waste;
5. the nuclide specific content of radioactive substances and a date of reference;
6. the level of external radiation at a specified distance and date;
7. the storage position; and
8. the date of treatment (for waste intended to be temporarily stored for more than two years the date for intended treatment shall be recorded).

A report concerning the past calendar year shall be sent to SSM. The report shall comprise a summary of:
1. which amount of waste that has arisen or by other means has been brought to the facility;
2. waste that has been registered according to section 6;
3. waste that has been transferred to disposal or has been transported away from the facility;
4. waste that at the turn of the year exists at the facility and information on its position; and
5. experiences of the handling of the waste and a follow-up of the plans established.

There are also regulations on the protection of human health and the environment in connection with the final management of spent nuclear fuel and nuclear waste (SSMFS 2008:37). The purpose of these regulations is to limit the harmful effects on human health and the environment in connection with the disposal of spent nuclear fuel and nuclear waste. Discharges to air and water from a facility to the surrounding environment are regulated in SSMFS 2008:23 (see section F.4.1.2).

In addition there are requirements concerning the long-term safety of a disposal facility in the regulations SSMFS 2008:21. According to the regulations, the safety assessment for a disposal facility should also comprise features, events and processes that can lead to the dispersion of radioactive substances after closure.

As presented in section E.2.2.3 regulations concerning clearance of nuclear and non-nuclear waste has been issued, SSMFS 2008:39 and SSMFS 2010:2, respectively.

H.1.1.3 Criticality and removal of residual heat

The revised general safety regulations (SSMFS 2008:1) state that radiological accidents shall be prevented by the design, construction, operation, monitoring and maintenance of a facility. It follows that a criticality analysis as well as an analysis of heat generation and removal of residual heat must be included in the safety report supporting the licence application for any nuclear facility.
The licence application for Clab included a criticality analysis as well as an analysis of heat generation. A re-assessment of both the criticality analyses and heat generation was performed and submitted in the application for ongoing extension works.

H.1.1.4 Interdependencies in waste management and minimisation of radioactive waste

The fact that the licence-holders are responsible for the handling and disposal of the radioactive waste they generate provides an incentive to consider all steps from waste generation to disposal. Detailed requirements are stipulated in SSM's regulations:

- An up-to-date inventory of all spent fuel and radioactive waste on-site (SSMFS 2008:1 and SSMFS 2008:22).
- Measures for the safe on-site handling, storage or disposal of waste shall be analysed and included in the safety report of the facility. The measures for on-site handling shall consider the requirements on safety posed by the continued handling, transport and disposal of the waste. The safety report shall also include measures, which need to be taken on-site to prepare for the safe transportation, storage or disposal in a nuclear waste facility (SSMFS 2008:1).
- If such waste is generated that does not conform to the specifications in the safety report, measures for the safe handling of this particular waste shall be documented and SSM notified before any measures are taken. The documentation is subject to a twofold safety review by the licensee before notification (SSMFS 2008:1).
- Plans shall be established for the handling and disposal of all waste that exists at the facility arises at the facility or in other ways is brought to the facility. The plans shall include e.g. amounts of different categories of waste, estimated nuclide specific content and sorting, treatment and interim storage of the waste. The plans shall be reported to the authorities before the waste is generated (SSMFS 2008:22).
- The possibility that radiation doses to personnel can increase when releases to the environment are limited shall be taken into account during optimisation, as shall the consequences of other waste management alternatives (SSMFS 2008:23).
- Human health and the environment shall be protected from detrimental effects of ionising radiation, during the time when various stages of the final management of spent nuclear fuel or nuclear waste are being implemented as well as in the future (SSMFS 2008:37).

H.1.1.5 Protection of individuals, society and the environment

General radiation protection provisions are described in section F.4.1.
SSM has particularly addressed radiation protection of the public and the environment in connection with radioactive waste management in three different regulations (SSMFS 2008:37, 2008:21 and 2008:22, see E.2.2.3). In summary it is required that:

- a disposal facility for spent nuclear fuel or nuclear waste shall be designed so that the annual risk of harmful effects after closure does not exceed 10E-6 for a representative individual in the group exposed to the greatest risk;
- the final management of spent nuclear fuel and nuclear waste shall be implemented so that biodiversity and the sustainable use of biological resources are protected: and
- human health and the environment shall be protected during the operation of a nuclear facility as well as in the future.

H.1.1.6 Biological, chemical and other hazards

An Environmental Impact Statement (EIS) must be submitted together with an application for a licence according to the Act on Nuclear Activities and the Radiation Protection Act, as accounted for in section E.2. It is stated in the general considerations in the Environmental Code that due consideration shall be taken to possible effects from chemical, biological and other hazards. It follows that chemical, biological and other hazards during the operation of a nuclear facility must be addressed in the EIS.

As stated in H.1.1.2 SSM requires that up-dated registers be kept for all waste and spent nuclear fuel at a nuclear facility. The registers shall for every waste item (e.g. package or component) include information on, among other things, the treatment and the physical and chemical form of the waste.

The question of chemical and biological hazards with regard to the long-term performance of a disposal facility is addressed in SSMFS 2008:21.

Only packages approved by SSM have been allowed to be transported to a disposal facility. For this approval, the waste must comply with the conditions stated in the safety report of the disposal facility. Furthermore, the licensee has to submit documentation showing that due regard has been taken to all relevant aspects, including biological, chemical and other hazards with regard to the long-term performance of the disposal facility.

H.1.1.7 Strive to avoid actions that impose impacts on future generations

One purpose of SSMFS 2008:22 is to limit the harmful effects of radiation from the waste today and in the future. In SSMFS 2008:23 it is also stated that human health and the environment shall be protected from the harmful effects of ionising radiation during the operation of a nuclear facility as well as in the future. SSMFS 2008:37 has general requirements stipulating that human health and the environment shall be protected from detrimental effects of ionising radiation, during the time when various stages of the final management of spent nuclear fuel or nuclear waste are being implemented as well as in the future. All these regulations strive

to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation.

H.1.1.8 Aim to avoid imposing burdens in future generations

As described in section E.2 the practices for the management of spent fuel and radioactive waste are governed by principles adopted by the Swedish Parliament. The first governing principle reads ”The expenses for the disposal of spent nuclear fuel and nuclear
waste are to be covered by revenues from the production of energy that has resulted in these expenses.” The second principle reads ”The reactor owners are to safely dispose of spent nuclear fuel and nuclear waste.”

The key words (underlined) imply that burden on future generations should be avoided, especially with regard to the fundamental aspects of safety and costs. The key words also imply that action should be taken without postponement, i.e. the generation that has benefited from the nuclear power generation should also deal with the management of spent nuclear fuel and radioactive waste.

Thus, the holder of a licence to operate a nuclear facility is primarily responsible for the safe handling and disposal of spent nuclear fuel and radioactive waste, as well as decommissioning and dismantling the facility.

H.1.2 Measures taken by the license holder

H.1.2.1 The general obligations of license-holders

Cost calculations

Cost calculations have since the beginning of the 1980’s been submitted by the license-holders of a nuclear reactor, in cooperation with the other holders of a license for the operation of nuclear power reactors, on an annual basis.SKB submitted in January 2011 the most recent cost calculations under the Act (2006:647) on Financial Measures for the Management of Residual Products from Nuclear Activities.

RD&D Programme 2010

The nuclear industry, through its co-owned company SKB, has performed research on final disposal of radioactive waste since the mid-1970’s. The formal requirement for a R&D-programme to be submitted for regulatory evaluation was established in 1984 when the Act on Nuclear Activities was promulgated. During the 1990s the research was intensified with extensive feasibility studies (in eight municipalities). In 2001-2002 two municipalities approved further investigations. The initial site investigations were concluded by the end of 2007 and the results reported in preliminary site descriptions. In June 2009 the board of SKB decided to choose Forsmark as site for the disposal facility for spent nuclear fuel. In March 2011, SKB’s applications for a permit to build a disposal facility system were submitted to the Swedish Radiation Safety Authority (SSM) and the Environmental Court in Stockholm. Since 1986 SKB has produced nine R&D programmes with KBS-3 as the main alternative for the disposal of spent fuel. SKB submitted in September 2010 the ninth RD&D-programme to the Government.

H.1.2.2 Basic provisions and license obligations

The measures taken by the licensees regarding general safety requirements are to be found in sections H.3.2, H.4.2, H.5.2 and H.6.2.

H.1.3 Regulatory control

H.1.3.1 The general obligations of license-holders

Nuclear waste fees and guarantees for 2010 and 2011
SSM reviewed the cost calculations and submitted a statement with suggestion for the size of fees and guarantees to the Government in October, 2009. The Government decided in December 2009 on the size of fees and guarantees for 2010 and 2011. SSM is currently reviewing the most recently submitted cost calculations to determine and suggest to the Government the size of fees and guarantees for 2012 through 2014.

Evaluation of the RD&D Programme 2010
SKB submitted in September 2010 the RD&D-programme 2010. The regulatory authorities have evaluated the programme and submitted a statement to the Government. The main conclusions from the regulatory review were:

- The account for the ongoing site investigations and other preparatory work to support a license application for the extension of the disposal facility for short-lived low- and inter mediate level waste could have been more detailed. SSM therefore recommended the Government to require SKB to conduct consultations with SSM, in order to be appropriately informed about the regulatory requirements on contents and quality of the collection of arguments and evidence ("Safety Case") in support of the application, planned to be submitted in 2013.
- SKB should, in close cooperation with the nuclear power reactor operators, further detail and develop the planning for decommissioning of the reactors as well as the assessments of different categories of waste expected to be generated during decommissioning.
- SKB should in the next RD&D-programme to be submitted in 2013, further develop detailed planning for the establishment of a disposal facility for long-lived low- and intermediate level waste.

H.1.3.2 Basic provisions and license obligations

Regulatory control of measures taken by the licensees regarding general safety requirements are to be found in sections H.3.3, H.4.3, H.5.3 and H.6.3.

H.1.4 Conclusion

Sweden complies with the obligations of Article 11.

H.2 Article 12: EXISTING FACILITIES AND PAST PRACTICES

Each Contracting Party shall in due course take the appropriate steps to review:

(i) the safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;

(ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.

H.2.1 Regulatory requirements

H.2.1.1 Existing facilities

By the time the Joint Convention entered into force for Sweden the situation as regards safety of radioactive waste management facilities was satisfactory.

The elements of the Joint Convention are since long implemented as requirements in the legal and regulatory framework and implemented in the management of radioactive waste. Dedicated inspection and review activities carried out in the early 2000's confirmed that the licensee's activities were in conformance with the legal and regulatory requirements. This conclusion has been reaffirmed during subsequent inspection and review activities.

H.2.1.2 Past practices

As described in the introduction, section A.5.2.7, a special fee is levied on the nuclear power utilities in accordance with a special law, the Studsvik Act, to cover expenses for managing nuclear waste from old experimental facilities, in particular the facilities at Studsvik, the Ågesta reactor and the uranium mine in Ranstad. The special fee is the same for all four nuclear power utilities, currently SEK 0.003 per kilowatt-hour, and it is reassessed annually based on a proposal by the regulatory authority.

H.2.2 Measures taken by the license holders

H.2.2.2 Past practices

The four utilities operating nuclear power reactors in Sweden formed a special company, AB SVAFO (Sydkraft, Vattenfall, Forsmark och OKG) to deal with their responsibilities according to the Studsvik Act (See E.2.2.6). AB SVAFO was formerly owned by Studsvik Nuclear AB but was in March 2009 acquired by the nuclear power producers in Sweden (Forsmarks Kraftgrupp AB, Ringhals AB, Barsebäck Kraft AB and OKG AB).

According to estimates, SEK 1.8 billion (equivalent to approx. € 120 million) will be needed up to the year 2045 to meet the expenses for these activities. The activities performed by AB SVAFO are closely monitored by SSM.

H.2.3 Conclusion

Sweden complies with the obligations of Article 12.

H.3 Article 13: SITING OF PROPOSED FACILITIES

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility
   (v) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;
   (vi) to evaluate the likely safety impact of such a facility on individuals, society and the environment;
   (vii) to make information on the safety of such a facility available to members of the public;
   (viii) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.
2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.

H.3.1 Regulatory requirements

H.3.1.1 Assessment of safety and environmental impact

According to the Act on Nuclear Activities a licence is required to construct, possess and operate any nuclear facility. A licence application must contain an EIA. The procedures for carrying out the EIA, as well as its contents, are specified in the Environmental Code (see section E.2.2.4). The licensing procedure is described in section E.2.3.1. The EIA must contain the following elements:

- A description of the activity or measure with details of its location, design and scope.
- A description of the measures being planned with a view to avoiding, mitigating or remedying adverse effects.
- The information needed to establish and assess the main impacts on human health, the environment and management of land, water and other resources that the activity or measure is likely to have.
- A description of possible alternative sites and alternative designs, together with a statement of the reasons why a specific alternative was chosen and a description of the consequences if the activity or measure is not implemented.
- A non-technical summary of the information.

In addition to the EIA the preliminary safety report for a proposed spent fuel management facility is of key importance for licence application. Requirements on the content of the safety report are given in the general regulations concerning safety in certain nuclear facilities (SSMFS 2008:1), and include for example:

- A description of how the site and its surroundings, from the standpoint of safety, can affect the facility.
- A description of the design basis, including the requirements that have determined the design and construction of the facility. Descriptions of facilities for the handling of spent fuel or nuclear waste shall contain requirements that are determined by the description of safety in the particular disposal facility after closure.
- A description of measures taken to ensure adequate protection of workers, the public and the environment from radiation, as required by the Radiation Protection Act and regulations promulgated according to that act.

As described in section E.2.2.1 the operators of nuclear power plants must jointly perform a comprehensive R&D-programme for the safe management of spent nuclear fuel and nuclear waste. The purpose of this programme is to demonstrate that timely actions are taken to evaluate the safety and impacts of proposed facilities and that all relevant site-related factors are studied. The programme must be submitted every third year for regulatory review.

H.3.1.2 Public information and involvement

There are several procedures that serve the purpose to involve the public in the siting of new spent nuclear fuel and nuclear waste facilities. As mentioned above, an EIA must be performed for any new nuclear facility. Swedish legislation emphasizes the role of the public and other stakeholders in the EIA. The developer must initiate early (long before a licence application is submitted) consultations with those parties that might be affected by a new facility.
Parties that must be consulted include:

- municipalities that may host the facility;
- regulatory authorities, primarily SSM and County Administrative Boards;
- national environmental organisations;
- local interest groups; and
- affected individuals, e.g. those living close to a proposed location.

The County Administration Boards have an important function besides participating in the consultations. They are requested to assist the developer in identifying stakeholders and to facilitate consultations and an exchange of information.

Furthermore, the circulation of the nuclear power plants' joint R&D programme for comments provides a broad range of concerned parties with information regarding new facilities as well as a possibility to state opinions.

According to the Act (1992:1537) and Ordinance (1981:671) on the Financing of Future Expenses for Spent Nuclear Fuel etc., the municipalities that might host a spent nuclear fuel or nuclear waste facility, including a disposal facility, are reimbursed for their own information to the public. Municipalities have been reimbursed for their information activities since the mid-1990s. Currently the municipalities of Östhammar and Oskarshamn are receiving reimbursement. In 2004

the Parliament approved a new regulation in the Financing Act, which made it possible for non-profit-making organisations to apply for financing. Non-profit-making organizations are entitled to financial support from the Nuclear Waste Fund until 12 months after the Environmental Impact Assessment has been announced by the Environmental Court (for details see section E.2.2.4). Decisions concerning reimbursement to municipalities and non-profit organisations are made by SSM.

H.3.1.3 Consulting contracting parties

The Environmental Code specifies that if another country is likely to be affected, the responsible authority as designated by the Government shall inform the competent authority in that country about the planned activity. The country concerned, and the citizens, who may be affected, should be given the opportunity to take part in the consultation procedure. The Government has designated the Swedish Environmental Protection Agency to be responsible for this task. Such information shall also be supplied when another country, which is likely to be exposed to a significant environmental impact, so requests.

H.3.2 measures taken by the license holders

H.3.2.1 General

All planned spent fuel and nuclear waste facilities, including repositories, will be sited, constructed and operated by SKB. The supporting RD&D-programme is also run by SKB. The following activities are currently carried out by SKB:

- The RD&D-programme has been reported every third year since 1986. The most recent RD&D report was submitted in 2010.
- Consultations and an EIA for the planned encapsulation facility (Clink) and the disposal facility for spent nuclear fuel began formally in 2002, but in practice started in the mid-1990's. The consultations were concluded in May 2010.

H.3.2.2 Consultations and environmental impact statement

Early consultations have been carried out for both the encapsulation plant and the disposal facility for spent nuclear fuel, in both Oskarshamn and Forsmark.

Extended consultations began during 2003 with the county administrative board, other government agencies, the municipalities, the citizens and the organizations that are likely to be affected. The consultations were coordinated for the encapsulation plant and disposal facility for spent nuclear fuel. The consultations related to location, scope, design and environmental impact of the activity or measure and the content and structure of the environmental impact statement.

The extended consultations initially mainly dealt with the scope of EIA. Preliminary scoping reports were prepared as a basis for discussion. Viewpoints and proposals that emerged during the consultations were taken into account in the planning of the continued EIA process.

In the subsequent investigation phase, results from investigations and studies as well as proposals for facility design were presented at the consultation meetings, and the participants were given an opportunity to state their views.

In May 2010, the consultations were concluded. All questions and viewpoints that have been stated in the conclusions, together with SKBs answers and comments, are reported in its whole in the compiled documentation from the conclusions.

A preliminary version of the environmental impact statement (EIS) for the whole disposal system, including the spent fuel disposal facility in Forsmark, has been presented within the framework of the EIA consultations. In addition to the formal consultations, extensive information activities have been aimed at municipalities, organizations and the public.

The last facility that will be built in the LILW programme is the disposal facility for long-lived low and intermediate level waste, SFL. A decision on the siting of this facility will be made in a couple of decades at the earliest.

H.3.3 Regulatory control

SSM reviews SKB's R&D programme and circulates it for comments to a number of concerned organisations (e.g. universities, government agencies, NGOs and municipalities that might host a spent nuclear fuel facility). When the review is completed the R&D programme together with SSM's recommendations are sent to the Government for its decision.

SSM have regular consultations with SKB regarding progress in the siting of the planned facilities.

SSM is consulted regarding the EIA. The concerned County Administrative Boards are also consulted regarding the EIA and thus exercise some regulatory control, however not in the fields of nuclear safety and radiation protection.

H.3.4 Conclusion

Sweden complies with the obligations of Article 13

H.4 Article 14: DESIGN AND CONSTRUCTION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:
(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;
(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;
(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;
(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

H.4.1 Regulatory requirements

The general safety regulations (SSMFS 2008:1) apply to the operation of all types of nuclear installations, including facilities for treatment, storage and disposal of spent fuel and radioactive waste.

H.4.1.1 Suitable measures to limit radiological impact

The requirements for limiting the possible radiological impact on individuals, society and the environment, including those from discharges or uncontrolled releases, are founded upon the basic provisions stipulated in the Act on Nuclear Activities (1984:3). This is clarified further in the general safety regulations (SSMFS 2008:1) in which it is stated that nuclear accidents shall be prevented through a basic facility-specific design that shall incorporate multiple barriers as well as a facility-specific defence-in- depth system.

Defence-in-depth shall be achieved by:
- ensuring that the design, construction, operation, monitoring and maintenance of a facility is such that abnormal events, incidents and accidents are prevented;
- ensuring that multiple devices and measures exist to protect the integrity of the barriers and, if the integrity should be breached, to mitigate the ensuing consequences; and
- ensuring that any release of radioactive substances, which may still occur as a result of abnormal events, incidents and accidents, is prevented or, if this is not possible, controlled and mitigated through devices and prepared measures.

H.4.1.2 Conceptual plans and provisions for decommissioning

The Act on Nuclear Activities states that the holder of a licence for nuclear activi-

ties is responsible for ensuring that all necessary measures are taken to ensure the safe handling and disposal of nuclear waste, or nuclear material that is not reused, as well as the safe decommissioning and the dismantling of facilities.

Chapter 9 of the general regulations concerning safety in nuclear installations (SSMFS 2008:1) contains requirements on decommissioning plan and a specific operational safety assessment to be carried out as soon as a decision has been taken on final closure of a disposal facility.

The regulations on planning before and during decommissioning of nuclear facilities (SSMFS 2008:19) comprises requirements for decommissioning with respect to documentation, alternative actions and waste management with regards to radiation protection.

H.4.1.3 Technology provisions for closure of repositories

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) stipulate that analyses of conditions that are of importance for the safety of a facility shall be carried out before a facility is constructed and taken into operation. This is further specified in the regulations concerning safety in connection with the disposal of nuclear material and nuclear waste (SSMFS 2008:21) where it is stipulated that for repositories, the safety assessments shall also comprise features, events and processes that can lead to the dispersion of radioactive substances after closure. Such safety analyses shall be made before the commencement of disposal facility construction, operation and closure.

H.4.1.4 Technology supported by experience

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) specify requirements regarding design and construction. It is stated that the design of the facility, with adaptation to the specific conditions of each facility, shall:

- be able to withstand component and system failures;
- have reliability and operational stability;
- be able to withstand such events or conditions which can affect the safety function of the barriers or defence-in-depth; and
- have maintainability, controllability and testability of inherent parts as long as these parts are used for their intended purposes.

Additional requirements related to design and construction are:

- The design principles and design solutions shall be tested under conditions corresponding to those that can occur during the intended application in a facility. If this is not possible or reasonable, they must have been subjected to the necessary testing or evaluation related to safety.
- The design solutions shall be adapted to the personnel's ability to manage the facility, in a safe manner, under normal conditions as well as during abnormal events, incidents and accidents that might occur.
- Building components, devices, components and systems shall be designed, manufactured, installed, controlled and tested in accordance with requirements that are adapted for their importance for safety.

H.4.2 Measures taken by the license holders

H.4.2.1 Suitable measures to limit radiological impact

The safety philosophy applied in the design of all Swedish nuclear facilities is based on the principles of defense in depth and of multiple barriers to prevent the release of radioactive material to the environment. They are all designed to fulfill the intention of the requirements in the General Design Criteria. The foundation of the safety principle on the defense in depth is emphasized and made clearer through the implementation of that principle in the general regulations concerning safety in nuclear installations (SSMFS 2008:1).

H.4.2.2 Conceptual plans and provisions for decommissioning

Decommissioning plans have been developed by SKB, as part of the basis for the annual cost calculations (see section E.2.2.5).

H.4.2.3 Technology provisions for closure of repositories

Technical provisions for the closure of the disposal facility for operational waste (SFR) have been part of the safety assessment performed before SFR was constructed. An updated safety analysis was reviewed before the facility was taken into operation.

H.4.2.4 Technology supported by experience

The principle of proven technology is broadly accepted and implemented in the design and construction procedures for Swedish nuclear facilities. The use of properly environmentally qualified equipment ensures functioning of safety-related systems and components under emergency conditions. A comprehensive programme for environmental qualification has been carried out. No major new steps are envisaged in addition to the previous programme, although research and development continues. In the modernization work, the specification of all new installations is carefully checked with respect to environmental requirements.

H.4.3 Regulatory control.

During the licensing process the PSAR, SAR and OLC documents are reviewed by the regulatory
authorities to ensure compliance with fundamental safety principles and criteria. A prerequisite for obtaining a licence is that the regulatory review concludes that the facility is designed according to the provisions in the general regulations concerning safety in nuclear installations (SSMFS 2008:1).

H.4.4 Conclusion

Sweden complies with the obligations of Article 14.

H.5 Article 15: ASSESSMENT OF SAFETY OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:
(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;
(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;
(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

H.5.1 Regulatory requirements

H.5.1.1 Assessment of safety

Requirements on the safety assessment, safety review and reporting are listed in the general regulations concerning safety in nuclear installations (SSMFS 2008:1). Many of these requirements are not new but were posed earlier as licensing conditions for facilities licensed before the regulations came into force. Some of the requirements are, however, more comprehensive compared to earlier conditions, and some are new.

The legally binding requirements regarding safety assessments are summarised in the following points:

- A comprehensive safety analysis shall be performed before a facility is constructed and before it is taken into operation. The analysis shall subsequently be kept up-to-date. The analysis shall be based on a systematic inventory of events, event sequences and conditions that can lead to a radiological accident.
- A preliminary safety report shall be prepared before a facility may be constructed. The safety report shall be updated before trial operation of the facility may be started. . The safety reports shall contain information as specified in the regulations The safety report shall be supplemented before the facility is taken into routine operation. The safety report shall subsequently be kept up-to-date. The safety reports shall be reviewed, evaluated and approved by the regulatory authority as required.

The general safety regulations SSMFS 2008:1, apply to the operation of all types of nuclear installations, including facilities for treatment, storage and disposal of spent fuel and radioactive waste. The basic provisions regarding safety assessment and review and can be summarised in the following points:

Safety Analysis
Analyses of conditions that are of importance for the safety of a facility shall be carried out before a facility is constructed and taken into operation. The analyses shall subsequently be kept up-to-date. The safety analyses shall be based on a systematic inventory of such events, event sequences and conditions that could lead to a radiological accident.

Safety Report
A preliminary safety report shall be prepared before a facility may be constructed. The safety report shall be updated before trial operation of the facility may be started. The safety report shall be supplemented before the facility is taken into routine operation. The safety report shall subsequently be kept up-to-date. The content of the safety report is specified in the regulations. Before the facility may be constructed and taken into operation, the safety report shall be evaluated and approved by SSM. The safety report shall subsequently be kept up-to-date. In the updating of the regulations it has been clarified that the safety report (SAR) shall reflect the plant as built, analysed and verified and show how the valid safety requirements are met. Plant modifications shall be assessed against conditions described in the SAR. It has further been clarified that all plant structures, systems and components of importance for the defence-in-depth shall be described in the SAR, not only the safety systems. New safety standards and practices, which have been assessed by the licensee and found applicable, shall be documented and inserted into the SAR as soon as corresponding modifications or other plant measures have been taken. A few additional requirements on the contents of the SAR have also been added.

Safety Review
A safety review shall determine or check that the applicable safety related aspects of a specific issue have been taken into account and that SSMFS 2008:1 appropriate safety-related requirements with respect to the design, function, organisation and activities of a facility are met. The review shall be carried out systematically and shall be documented. A safety review shall be performed within those parts of the organisation responsible for the specific issues (”primary review”). A second safety review shall be performed by a safety review function appointed for this purpose and that has an independent position relative those parts of the organisation responsible for the specific issues (”secondary review”).

Safety Programme
After it is taken into operation, the safety of a facility shall be continuously analysed and assessed in a systematic manner. Any need for improvement regarding safety measures, engineering or organisational issues, which arise as a result of such analyses and assessments, shall be documented in a safety programme. The safety programme shall be updated on an annual basis.

Periodic Safety Review of Facilities
At least once every ten years, a new, integrated analysis and assessment of the safety of a facility shall be performed. The analyses and assessments, as well as the measures proposed on the basis of these shall be documented and submitted to SSM. In the most recent update of the general regulations, the requirements on Periodic Safety Review (PSR) have been made more stringent in order to use these reviews for assessment of time limited licensing conditions. This means that the Swedish approach to PSR becomes more in line with the European approach, where PSR is often used in the re-licensing of the nuclear power facilities.

Modifications
A safety review shall be performed for engineering or organisational modifications to a facility, which can affect the conditions specified in the safety report as well as essential modifications to the report. Before the modifications may be included in the report, SSM shall be notified and the Inspectorate can decide that additional or other requirements or conditions shall apply with respect to the modifications.

Post Closure Safety
Additional requirements concerning the long-term safety of a disposal facility are stipulated in the regulations concerning safety in connection with he disposal of nuclear material and nuclear waste (SSMFS 2008:21) as well as Regulations and General Advice on the Protection of Human Health and the Environment in connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste (SSMFS 2008:37). According to the regulations, the safety assessment for a disposal facility shall also comprise features, events and processes that can lead to the dispersion of radioactive substances after closure. Such safety assessments shall be made before disposal facility construction, before operation and before closure. The safety assessment shall cover as long a time as barrier functions are required, but at least ten thousand years.

H.5.1.2 Environmental assessment

The Act on Nuclear activities also states that an EIA (Environmental Impact Assessment) must be carried out for all licensing cases, and that the Environmental Code regulates the way in which the EIA shall be carried out as well as the contents of the documentation in the EIS. Requirements on environmental assessment are laid down in the Environmental Code (1998:808) as described in Section E.2.2.4.

The purpose of an EIA is to establish and describe the direct and indirect impact of a planned activity or measure as listed below. Another purpose is to enable an overall assessment to be made of this impact on human health and the environment. An environmental impact statement shall contain the following information:

- A description of the activity or measure with details of its location, design and scope.
- A description of the measures being planned with a view to avoiding, mitigating or remedying adverse effects, for example action to prevent the activity or measure leading to an infringement of an environmental quality standard.
- The information that is needed to establish and assess the major impact on human health, the environment and the management of land, water and other resources that the activity or measure is likely to have.

- A description of possible alternative sites and alternative designs, together with a statement of the reasons why a specific alternative was chosen as well as a description of the consequences if the activity or measure is not implemented.
- A non-technical summary of the information.

H.5.1.3 The licensing procedure

Three different permits/licences are required for a nuclear facility: a permit under the Environmental Code (1998:808), a licence under the Act (1984:3) on Nuclear Activities (1984:3), and a building permit under the Planning and Building Act (2010:900). Licensing under the Environmental Code and the Act on Nuclear Activities occur in parallel. The applications under both laws must include an environmental impact statement (EIS) prepared according to the rules in Chapter 6 of the Environmental Code. The same EIS is thus used in both applications.

According to Chapter 17 of the Environmental Code, the Government shall, after preparation by the Environmental Court, examine the permissibility of the activity. After SSM's preparation of the matter, the Government shall also examine permit applications under the Act on Nuclear Activities. If the Govern ment finds that the construction and operation of the facility is permissible according to the Environmental Code and grants a permit/licence under the Act on Nuclear Activities, it remains for the Environmental Court to grant a permit/licence and stipulate conditions in accordance with the Environmental Code.

H.5.2 Measures taken by the license holders

SKB submitted an updated safety assessment for the disposal facility for operational waste (SFR) in 2001. The regulatory review was finalised late 2003 and resulted in requirements on SKB to perform and submit complementary analyses. An updated SAR was submitted to the regulatory authorities in early 2008.

Short-lived operational and decommissioning waste

Site investigations for the extension of SFR, with test drilling and other investigations of the rock with associated analyses, will be concluded during the first half of 2011. Preliminary assessments show that there are rock volumes in the investigation area that are suitable for an extension of SFR.

According to the Act (1984:3) on Nuclear Activities a government license is required to extend SFR. In the application, SKB will present the technical supporting material that is required to determine whether the existing and extended facility meets the requirement made under the Act (1984:3) on Nuclear Activities. A preliminary safety analysis report (PSAR) of operational safety and post-closure safety will be included in the application. SKB will also apply for a permit from the Environmental Court under the Environmental Code for the entire SFR facility.

When all necessary licenses have been obtained, the construction works may begin. SKB must consider the consequences of the conditions in the licenses before the start of construction and adapt the planning accordingly.

When the facility has been built and processes function as intended, SKB will submit an application for a license to commence trial operation. The application

will contain a an updated safety analysis report (SAR) with updated assessments of pre-closure and post-closure safety, plus updated safety-related technical specifications. The purpose of the trial operation is to gather experience in preparation for routine operation.

Long-lived operational and decommissioning waste
At the start of 2012, SKB plans to apply to French authorities for licensing of a transport cask (ATB 1T) for transport of BFA tanks containing long-lived low- and intermediate level waste. Validation of this licence will be performed by SSM.

SKB plans to commence interim storage in SFR of long-lived waste from the nuclear power plants when routine operation for the extended facility begins. An account of different disposal facility concepts for SFL, including a qualitative assessment of their long-term safety function, will be presented in 2013. The goal of the study is to choose one or a couple of disposal facility concepts to proceed with. Together with the results of other SFL work, the study will serve as a basis for continued efforts to compile supporting material for the safety assessment planned for 2016.

Based on the results of the assessment of long-term safety that is planned for 2016, preliminary requirements can be made on the site for the disposal facility (SFL). The continued research and safety assessment work will probably lead to modifications of these requirements before they are used to evaluate a candidate disposal facility site

SKB is carrying out unit-specific decommissioning studies together with the nuclear power companies to accumulate a more detailed body of data for estimating waste volumes, material quantities, activity quantities and decommissioning costs for the nuclear power plants. The results of the studies will serve as a basis for designing the capacity of future repositories for decommissioning waste and for the safety assessments required in the licensing process.

H.5.3 Regulatory control

The safety case as a basis for licensing and nuclear supervision
The safety level to be attained and maintained by the licensee of a nuclear facility is defined in the licensing process.

The licence to build, possess and operate the facility is granted by the Government. This government licensing decision is applied for and granted early in the design process. These licence conditions requires that a preliminary safety report (PSAR) be submitted and approved by the regulatory body before major construction activities are started. A renewed safety report (SAR) and operational limits and conditions (OLC) should also be submitted and approved by the regulatory body before trial operation commences and a supplemented SAR should be submitted and approved by the regulatory body before routine operation commences . For a disposal facility, the safety assessment should comprise features, events and processes that can lead to the dispersion of radioactive substances after closure, as described in section H.5.1.1. Such a safety assessment shall be made before disposal facility construction, and before operation and before closure.

The PSAR, SAR and OLC documents are reviewed by the regulatory authorities, to ensure compliance with fundamental safety principles and criteria. Based on this licensing procedure, and on approval by the regulatory authorities,

the SAR and OLC documents become the legally binding documents regulating technical configuration and operating limits and conditions, often referred to as ”the safety case”. This ”safety case” may be regarded as defining the minimum safety level that the licensee is legally committed to maintain as a condition for a permit to operate the facility. Hence, the safety case also provides the basis for regulatory supervision.

Additional licence conditions can be prescribed by the regulatory authority over time, based on national and international operating experience and new research results.

H.5.4 Conclusion

Sweden complies with the obligations of Article 15.

H.6 Article 16: OPERATION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

(v) procedures for characterisation and segregation of radioactive waste are applied;

(vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

H.6.1 Regulatory requirements

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) contain legally binding requirements relevant for all the obligations of Article 16. These requirements are summarised below.

H.6.1.1 Initial authorisation

As mentioned in section H.5, a preliminary comprehensive safety report is required before the construction of a spent nuclear facility. A complete safety report, which also takes into account the results from commissioning tests, is required before the facility is taken into operation.

H.6.1.2 Operational limits and conditions

Documented up-to-date Operational Limits and Conditions (OLCs) are required containing the necessary operational limits and conditions, as further specified in a separate appendix to the regulations. The OLCs shall together with the operating procedures ensure that the conditions postulated in the safety report are maintained during the operation of the facility. The OLC's shall be subjected to a twofold safety review by the licensee and submitted to the regulatory authority for approval. The licensee shall notify regulatory authority about any changes, after they have been subjected to a two-fold safety review.

H.6.1.3 Established procedures

Suitable, verified and documented procedures are required for all operational states including accidents. The procedures for operability verification and procedures used in other operational states than normal operation shall be subjected to a twofold safety review by the licensee. Procedures for maintenance important for safety are also covered by the requirement. Maintenance programmes shall be documented. Inspection and testing of mechanical components shall be carried out according to qualified methods and verified procedures.

H.6.1.4 Engineering and technical support

The licensee shall ensure that adequate personnel is available with the necessary competence and suitability needed for those tasks which are important for safety, and also ensure that this is documented. A long-term staffing plan is required. The use of contractors as opposed to own personnel should be carefully considered in order to develop and maintain adequate in-house competence. The necessary competence should always exist in-house for ordering, managing and evaluating the results of work carried out by contractors of importance for safety.

H.6.1.5 Procedure for characterisation and segregation of waste

All waste to be disposed of in SFR, which is described in detail in section D.1.4.3, must conform to predefined waste acceptance criteria. The characteristics of each waste type are documented in a Waste Type Description (WTD). The WTDs are prepared by the waste producer in close contact with the licence holder of SFR (SKB). The completed WTD is submitted to SSM for approval. SSM reviews the WTD and may issue specific conditions for the disposal of particular waste type. To ensure consistent and comparable WTDs, guidelines have been issued for the structure and content of the WTDs.

Waste to be disposed of in shallow land burial facilities are specified and described in the licences (see section D.1.4.4). The licensee must notify SSM at least 3 months in advance of each disposal campaign and must then provide information about each waste package.

H.6.1.6 Reporting of incidents in a timely manner

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) contains one chapter about reporting requirements and an annex specifying these requirements for various types of events. The following is a brief summary:

- Reporting without delay: emergency alarm events and events and conditions in category 1 (see below).
- Reporting within 16 hours: INES events at level 2 or higher.
- Reporting within 7 days: a comprehensive investigation report about alarm events or events and conditions in category 1.
- Reporting within 30 days: a comprehensive investigation report of events and conditions in category 2.

In addition, there are requirements on daily reporting of the operational state, and the occurrence of any abnormal events or disturbances, and requirements on a comprehensive annual report summarising all experience important for the safety of the plant. Specifications are given about the contents of the different reports and further interpretation of the reporting requirements is given in the general recommendations.

In one of the basic paragraphs of SSMFS 2008:1, requirements are given on actions to be taken by the licensee in cases of deficiencies in barriers or in the defence-in depth system. These actions include first assessment, adjustment of the operational state, implementation of necessary measures, performance of safety reviews and reporting to SSM. A graded approach is allowed here.

In appendix 1 of the regulations, events and conditions are specified which require different responses, depending on the category of events they belong to. Three categories are defined:

Category 1
Severe deficiency observed in one or more barriers or in the defence-in-depth system, as well as a founded suspicion that safety is severely threatened. (In these cases the facility must be brought to a safe state without delay).

Category 2
Deficiency observed in one barrier or in the defence-in-depth system, which is less severe than that which is referred to in category 1, as well as a founded suspicion that safety is threatened. (In these cases the facility is allowed to continue operation under certain limitations and controls).

Category 3
Temporary deficiency in the defence-in-depth system, which arises when such an event or condition is corrected and which, without measures could lead to a more severe condition, and which is documented in the Technical Specifications. In all three cases, corrective measures shall be subject to a twofold safety review by

the licensee. The results of these reviews shall be submitted to SSM. Regarding category 3 events, there is no requirement to make a specific report to SSM. It is sufficient to make a compilation of these events in the annual report.

H.6.1.7 Programmes to collect and analyse operating experience

The licensee shall ensure that experience from its own facilities and from similar activities in other relevant facilities is continuously analysed, used and communicated to the personnel concerned (SSMFS 2008:1). It is further required that all events and conditions which are detected and which are important to safety are investigated in a systematic manner, in order to determine sequences and causes, as well as to establish the measures needed in order to restore the safety margins and to prevent recurrence.

The results of the investigations shall be disseminated within the organisation and shall contribute to the development of safety at the facility. In accordance with SSMFS 2008:1 it is the responsibility of the licensee, as long as the disposal facility is in operation, to continuously keep informed of the conditions of importance to the assessment of disposal facility safety, also after closure.

H.6.1.8 Decommissioning plans

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) a chapter on decommissioning has been added with requirements on:

- A preliminary plan for the future decommissioning of the facility to be compiled as before construction of a facility.
- The decommissioning plan to be supplemented and incorporated into the facility's safety report before the dismantling of the facility may be initiated
- A decommissioning plan and a specific operational safety assessment to be done as soon as a decision has been taken on final closure of a facility.

The plan should include measures, which must be implemented to ensure the safe containment of the generated nuclear waste.

H.6.1.9 Plans for closure of disposal facility

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) states that a facility for the disposal of nuclear waste shall be designed so that the barriers can provide the required safety without monitoring or maintenance after the disposal facility is closed. The regulations concerning safety in connection with the disposal of nuclear material and nuclear waste (SSMFS 2008:21) specify that the safety assessments for a disposal facility shall also comprise features, events and processes which can lead to the dispersion of radioactive substances after closure, and that such analyses shall be made before disposal facility construction, before operation and before closure.

The safety assessment for a disposal facility shall cover as long a time barrier as functions are required, but at least ten thousand years. In addition the regulations specify that it is the responsibility of the licensee, as long as the disposal

facility is in operation, to continuously keep themselves informed of conditions of importance to the assessment of disposal facility safety, also after closure.

H.6.2 Measures taken by the license holders

No radioactive waste management facility has been commissioned since 1988 when the disposal facility for radioactive operational waste (SFR) was licensed for operation. As described in the introduction, two additional facilities need to be constructed and taken into operation: a disposal facility for short-lived low and intermediate level decommissioning waste, and a disposal facility for the disposal of long-lived low and intermediate level waste.

The general regulations concerning safety in nuclear installations (SSMFS 2008:1) contain legally binding requirements relevant for all obligations of Article 9. These requirements are summarised below.

H.6.2.1 Initial authorisation

According to current plans, SKB is to submit a licence application for a disposal facility for short-lived low and intermediate level decommissioning waste in 2013, and operation is planned to commence in 2020. The disposal facility is planned to be co-sited with the existing disposal facility for radioactive operational waste (SFR). An expansion of this facility to accommodate short-lived decommissioning waste was foreseen in conjunction with planning and licensing and is still judged to be the best solution for this waste.

Also according to current plans, the disposal facility for long-lived low- and intermediate level waste will be sited in about 2035. The origin of this waste is primarily research, industry, medical applications, corecomponents and certain internal components from nuclear power reactors. The waste is currently stored at Studsvik, at the nuclear power plants, and at Clab. A dry interim storage for long-lived waste, from other power plants than Oskarshamn, will be put into operation for dry interim storage.

H.6.2.2 Operational limits and conditions

The operational limits and conditions for nuclear facilities are described in the operational limits and conditions (OLC), a document, which is considered to be one of the cornerstones in the governing and regulation of the Swedish nuclear activities. Every OLC is facility-specific and is approved by SSM as part of the licensing condition.

The original OLC for each facility is derived from the safety analyses in the SAR, in which the behaviour of the facility is described. Corrections and updating takes place, when new and better knowledge is available, either from research, tests or operational experience. Suggestions for changes in OLC are reviewed carefully from the safety point of view at different levels in the operating organisation and are finally approved by the regulatory body, before they are included in the document.

The fact that OLC is reviewed and revised regularly has contributed to making it a living document. It is also part of the quality and management system and used frequently in particular by the operations staff. An essential part of OLC is the general clause that says ”...should any doubt appear about the interpretation of the text, the general purpose of OLC shall be guiding. This means that the facility

in all indefinite situations shall be maintained or brought respectively to a safe state.". Other parts of OLC are the description of the background to the document. The background description is important for preserving and transferring to new staff the knowledge and experience of those who participated in the original production of OLC. Modified and maintained equipment must pass an operability test to verify that the equipment fulfills specified operational requirements before being accepted for continuous operation.

H.6.2.3 Established procedures

All activities that directly affect the operation of the facility are governed by procedures of different kinds covering normal operation, emergency operation and functional tests. Maintenance activities according to an approved maintenance programme are also to a great extent accomplished according to procedures, however, not always as detailed as the operating procedures, in which activities are described in sequence, step by step. Signing off of the completion of steps carried out in the procedures is mandatory in most cases, in order to confirm the completion and facilitate verification.

The operating personnel are deeply involved in the production and revision of operating procedures. The development of procedures follows specified directives, which include the reviewing of the documents, normally, by more than one person other than the author, before being approved by the operations manager or someone else at the corresponding level. The same applies for the revision of procedures. The revision of procedures is to be carried out continuously, when new experience is obtained particularly in the case of maintenance procedures. Emergency procedures have been developed in order to deal with anticipated operational occurrences.

H.6.2.4 Engineering and technical support

The principles for staffing are reported in section F.2 (Human and financial resources). Competence that might not be completely available within the own organisation at all plants is for instance expertise and resources for materials and chemistry assessments, radiation shielding and environmental consequence calculations, expertise and resources for software for safety applications and also process control and measurement techniques. In particular the IT functions have normally been outsourced, but are still available on-site. The intention is always to have the ordering competence within the operating organisation, and the capability of evaluating the results of analyses, calculations, etc. performed by consultants.

H.6.2.5 Procedure for characterisation and segregation of waste

The responsibility for the collection, segregation, characterisation, treatment and conditioning of radioactive waste rests with the waste producer. The waste producers have therefore implemented routines for ensuring that the waste complies with the predefined WTDs or with the licence conditions for the shallow land burial facilities (see section H.6.1.5).

H.6.2.6 Incident reporting

Incidents significant to safety are reported according to the non-routine reporting requirements in the technical specifications. Two types of licensee event reports (LER) exist. The more severe one, called abnormal event, requires the facility to inform SSM within one hour. A final report shall be submitted within ten days from the time of the event and the analysis of the event and appropriate measures to prevent recurrence shall be approved by SSM. Only a very limited number of events of this category have occurred at the Swedish facilities over the years. These events are typically also of such a dignity to warrant reporting in accordance with the International Nuclear Event Scale (INES).

The other type of LER, called RO (Reportable Occurrence), is used for less severe events. This type of event is mentioned in the daily report, which is sent to the regulatory bodies, followed up by a preliminary report within seven days and a final report within 30 days. The reports are reviewed at different levels within the operating organisation and approved by the operations or production manager before submittal.

The front of the standardised report form describes the event in general: identification number, title, reference to OLC, date of discovery and length of time until corrective actions were completed, conditions at the time it occurred, system consequences, a contact person at the plant and activities affected by the event.

On the reverse side of the document a description of the event is given. The following titles are used:

- Event course and operational consequence;
- Safety significance;
- Direct and root causes;
- Planned/decided measures; and
- Lessons learned by the event.

If the description of the event is extensive additional pages may be attached to the form. Reports are also required in accordance with OLC when the permitted levels of activity release from the facility are exceeded or in the event of unusually high radiation exposure to individuals. These types of non-routine reporting are primarily directed towards SSM.

H.6.2.7 Operating experience analysis and feedback

The objective of the analysis and feedback programme concerning operating experience is to learn from their own and others' experience and thus prevent recurrences of events, particularly those that might affect the safety of the facility. The operating experience feed-back process consists of a wide variety of activities within the plant organisation as well as externally.

H.6.2.8 Decommissioning plans

As described in section H.6.1.8, the general regulations concerning safety in nuclear installations (SSMFS 2008:1) comprises requirements for the preparation of decommissioning plans for all nuclear facilities. So far only generic and general

decommissioning plans have been prepared as part of the basis for the nuclear power utilities' cost estimates for dismantling and disposal of spent fuel and radioactive waste (see section H.4.2.2).

H.6.2.9 Plans for closure of disposal facility

The closure of repositories will not take place for at least 30-50 years according to current plans. Closure is thus still part of SKB's RD&D programme and an issue for future safety assessments.

H.6.3 Regulatory control

H.6.3.1 Initial authorisation

The regulatory control is achieved through the procedures described in sections E.2.3.1 (Licensing) and E.2.3.3 (Institutional control, regulatory inspection and reporting).

H.6.3.2 Operational limits and conditions

SSM reviews applications for changes in OLC, and for exemptions from OLC. Based on the application and information provided by the licensees, and the associated safety analyses, assessments are made about how the proposed changes or exemptions contribute to the risk profile of the facility.

A few years ago, the regulatorinspected the training and retraining in OLC of operational, maintenance and technical support personnel. Included in the inspection was how documentation was used and kept up to date. The regulatory authority concluded that the use of OLC was well understood and the training of operational personnel was well organised. However, it was found that the training could be improved for other groups who come into contact with the requirements of OLC, for instance personnel in the maintenance and chemical departments. It was also concluded that updating OLC was sometimes slow, due to limited staff resources and that consultants were often used for this important task.

H.6.3.3 Procedures

Operational and maintenance procedures are normally not reviewed by SSM. Only in connection with event investigations would SSM ask for a procedure to be submitted for review. In the frame of quality assurance inspections or review of quality audits made by the licensees (see section F.3) have SSM looked into the routines used for updating procedures.

H.6.3.4 Engineering and technical support

SSM has not so far specifically inspected the engineering and technical support available at the facilities. In connection with other inspections and reviews, the staffing situation has occasionally been commented upon.

H.6.3.5 Characterisation and segregation of waste

As described in section H.6.1.5 all waste types must be approved by the regulatory function before disposal. Compliance with regulations is verified by inspections both at the waste producer and the operator of the disposal facility, e.g. SFR or shallow land burial facilities. The inspections cover e.g. administrative routines, documentation, equipment, and radiological measurements.

H.6.3.6 Incident reporting

Licensee event reports are reviewed upon arrival by the responsible site inspector, who asks the facility for clarification if necessary. As a routine all LERs are screened once a week by a standing group of inspectors and specialists in order to assess the event, the analysis and the measures taken by the licensees. If there has been any regulatory concerns the issue is brought up at a management meeting and a decision made about any further measures to be taken by SSM.

H.6.3.7 Experience feedback analysis

The regulatory control is achieved through the procedures described in section E.2.3.3 (Institutional control, regulatory inspection and reporting). The regulator has also in connection with event investigations and in connection with other inspections and reviews, followed up the experience feed back programme.

H.6.3.8 Decommissioning plans

The decommissioning plans (see section H.6.1.8) must be submitted to SSM for approval before the decommissioning and dismantling activities may be started.

H.6.3.9 Plans for closure of disposal facility

As described in section H.6.2.9 the closure of repositories is still an R&D issue and SKB has thus not yet presented any definite plans. It is however part of SKB's RD&D programme which is subject to regulatory review every third year. The long-term safety aspects of the backfill, which will be of key importance in the closure planning, have been identified as one area requiring significant efforts

H.6.4 Conclusion

Sweden complies with the obligations of Article 16.

H.7 Article 17: INSTITUTIONAL MEASURES AFTER CLOSURE

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

(i) records of the location, design and inventory of that facility required by the regulatory body are preserved;

(ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required; and

(iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

H.7.1 Records keeping

Generally, the implementing organisations are responsible for the development and management of records. Nevertheless, R&D is being carried out on these subjects. The regulations on filing at nuclear plants (SSMFS 2008:38) contains requirements for record management, under which specified documents concerning location, design and inventory of waste are required to be kept in archives, for more than 100 years. Relevant records will be transferred to national and regional official archives when facilities are decommissioned or closed. The authority's documents are regularly transferred to national archives as regulated in the Act on Archives (1990:7) and regulations issued by the National Archives of Sweden. This mechanism has been in place since 1618.

H.7.2 Measures taken by the license holders

The R&D activities performed by SKB as a basis for the design work on repositories is based on that the design shall be such that the safety of a closed disposal facility is not dependent on surveillance or monitoring, but that some institutional controls can be assumed to exist even after closure, for example safeguards.

H.7.3 Institutional control

Requirements for institutional control after closure are not established or formally decided. The general regulations concerning safety in nuclear installations (SSMFS 2008:1) stipulate that a facility for the disposal of nuclear waste shall be designed so that the barriers provide the required safety without monitoring or maintenance after the disposal facility is closed. This is further specified in the regulations concerning safety in connection with the disposal of nuclear material and nuclear waste (SSMFS 2008:21) in which it is stipulated that safety after closure of a disposal facility shall be maintained through a system of passive barriers. Also the regulations on the protection of human health and the environment in connection with the final management of spent nuclear fuel and nuclear waste (SSMFS 2008:37) require that the long-term performance of a disposal facility should not rely on any active measures.

The four shallow land burial facilities for low-level waste (Oskarshamn, Forsmark, Ringhals and Studsvik) - are located within the premises of the power plant or industrial facility at that location. Access restrictions to the repositories are, therefore, maintained through the access restrictions that apply for the entire facility.

In the case of SFR, relevant authorities have not yet decided what measures for institutional control, either active or passive, will apply post-closure. However, the basic philosophy is applicable, that high levels of safety and radiological protection of public health and the environment shall be independent on institutional control.

In the case of the four shallow land burial facilities for low-level waste, institutional control is requested for a period of up to 50 years after closure of the disposal facility. It is for the owner and operator of the disposal facility to demonstrate how the requirement for institutional control can be maintained over that period. For longer periods of time, it is foreseen that the environmental hazard and risk is principally of a non-radiological character. Prolonged requirements for institutional control may be issued by county or municipal administrations. The municipalities' detailed development plans are also of importance, by providing conditions concerning the use of the land. All nuclear facilities, including shallow land disposal facilities, are within areas where detailed development plans have been established.

Exempt waste may be deposited on municipal disposal sites, and will be subject to institutional control as decided by county or municipal authorities.

According to the regulations on the protection of human health and the environment from discharges of radioactive substances from certain nuclear facilities (SSMFS 2008:23), the holder of a licence shall conduct environmental monitoring. All discharges from facilities for the storage or disposal of radioactive waste shall be monitored by nuclide specific measuring programmes.

H.7.4 Intervention measures

As described above, the regulations (SSMFS 2008:1, 2008:21) stipulate that a facility for disposal of nuclear waste shall be designed so that safety after closure of a disposal facility is provided by a system of passive barriers. Prior to the disposal facility closure, the final safety assessment must be renewed and approved by the regulatory authority. If the regulatory authority approves the closure of the disposal facility the licence holder may be relieved from his responsibilities and obligations. Thus, if intervention measures are needed, it will be the responsibility of the State.

H.7.5 Conclusion

Sweden complies with the obligations of Article 17.

This page is intentionally left blank

I.1 Article 27: TRANSBOUNDARY MOVEMENT

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provi- sions of this Convention and relevant binding international instruments.
   In so doing:
   (i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary move- ment is authorized and takes place only with the prior notification and consent of the State of destination;
   (ii) transboundary movement through States of transit shall be subject to those interna- tional obligations which are relevant to the particular modes of transport utilized;
   (iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regu- latory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Conven- tion;
   (iv) a Contracting Party which is a State of origin shall autho- rize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to trans- boundary movement;
   (v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.
2. A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.
3. Nothing in this Convention prejudices or affects:
   (i) the exercise, by ships and aircraft of all States, of mari- time, river and air navigation rights and freedoms, as provided for in international law;
   (ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;
   (iii) the right of a Contracting Party to export its spent fuel for reprocessing;
   (iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

I.1.1 Regulatory requirement

There are four different Acts that must be considered in order to obtain a complete picture of the Swedish regulatory requirements regarding transboundary movement of spent nuclear fuel and radioactive waste:

- the Radiation Protection Act (1988:293);
- the Act (1984:3) on Nuclear Activities;
- Council Regulation (EC) No 428/2009; and
- the Act (2000:1064) on Control of Export of Dual-use Products and Technical Assistance.

Sweden has implemented Council Directive 2006/117/Euratom of 20 November 2006 on the super- vision and control of shipments of radioactive waste and spent fuel in the national legislation, i.e the Radiation Protection Act and the Act (1984:3) on Nuclear Activities.

In summary, and as specified in the Radiation Protection Act, a licence to export spent nuclear fuel or radioactive waste from Sweden cannot be granted if the destination is:

i. south of latitude 60 degrees south;
ii. a State party to the Fourth ACP-EEC Convention which is not a member of the European Union;
iii. a State that has forbidden the import of spent nuclear fuel or radioactive waste; or
iv. a State that, in the opinion of the responsible Swedish authorities, does not have the technical, legal or administrative resources to manage the spent nuclear fuel or administrative resources to manage the spent nuclear fuel or radioactive waste safely.

The Swedish Radiation Safety Authority has the jurisdiction to decide on the export of nuclear material and nuclear equipment as defined in the Annex 1, Category 0 of the Council Regulation (EC) No 428/2009 of 5May 2009. Export cases that are of a principle importance can be decided by the Government. An application for the export of spent fuel of Swedish origin must incude an assurance that the material will be returned to Sweden if it cannot be taken care of as planned.

SSM Regulations and general Advice on control of Nuclear Material etc. (SSMFS 2008:3) contains stringent national requirements in the field of nuclear non-proliferation. It establishes e.g. the procedure to fulfill the requirement in Council Regulation (EC) No 428/2009.

I.1.2 Regulatory control

Sweden follows the administrative procedures set forth in the Directive 2006/117/Euratom in order to ensure that states of destination and states of transit have the opportunity to give their prior consent, and are notified as is stated in the directive.

I.1.3 Experience of transboundary movements

Studsvik Nuclear AB carries out volume reduction of radioactive waste on a commercial basis, by incineration of combustible waste and melting of scrap metal. The activities are to a certain extent based on services to companies abroad, and

Studsvik imports radioactive waste and scrap metal for the purpose of volume reduction. The remaining radioactive waste is re-exported to the country of origin. Approximately one hundred transboundary shipments of this kind is carried out each year.

I.1.4 Conclusion

The Swedish party complies with article 27.

This page is intentionally left blank

J.1 Article 28: DISUSED SEALED SOURCES

1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.
2. A Contracting Party shall allow for re-entry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

Radiation Protection Act
All handling of disused sealed sources is covered by the Radiation Protection Act (1988:220). According to the Act, anyone that has conducted activities involving sealed sources has to ensure the safe management and disposal of the disused sealed sources, which also includes securing that there are financial resources secured for the handling and disposal of the disused sealed sources. The Radiation Protection Act allows the re-entry of disused sealed sources into its territory for return to Studsvik Nuclear AB (SNAB).

Regulations
Detailed requirements on the handling of disused sealed sources are found in the following regulations issued by the SSM.

- Regulations on the Control of High Activity Sealed Sources (SSMFS 2008:9) stipulate that high activity sources for which no further use is foreseen must be sent either to the supplier, to the manufacturer or to an approved facility for waste management within six months. The holder must notify the SSM which keeps a register.
- Regulations on Radiation Therapy (SSMFS 2008:33) stipulate that in the case of the purchase of radioactive sources or equipment, which contains such sources, a plan shall be drawn up for the future handling of radioactive waste.
- Regulations on Accelerators and Sealed Sources (SSMFS 2008:27) stipulate that the license-holder shall ensure that an up-to-date and documented plan exists for decommissioning the plant. The plan shall include an analysis of the resources needed to take care of all radioactive substances and radioactive demolition waste in a safe way from a radiation protection point of view.
- Regulations on the Use of Equipment in Industry Containing Sealed Sources or X-Ray Tubes (SSMFS 2008:40) stipulate that equipment containing a radioactive source for which no further use is foreseen, shall be sent to a radioactive waste management facility within six months.
- Regulations on Smoke Detectors for Domestic Use Containing Radioactive Sources (SSMFS 2008:47) stipulate that the units are collected and sent for dismantling.
- Regulations on Smoke Detectors for Industrial Use Containing Radioactive Sources (SSMFS 2008:47) stipulate that the disused units should be taken care of as radioactive waste and returned to the supplier or manufacturer.

- Regulations on Import, Export and Reporting on Radioactive Substances (SSMFS 2008:10) stipulate that to import or export disused sealed sources a license is needed and the import/export must be reported to the competent authorities.

In addition to the regulations, the SSM also can issue license conditions that concern the management of disused sealed sources.

Producer's Responsibility Ordinances
Two ordinances establish producer's responsibility for disused sealed sources: the Ordinance on Producer's Responsibility for Electrical and Electronic Equipment (2005:209) and the Ordinance on Producer's Responsibility for Certain Radioactive Products and Orphan Sources (2007:193). In effect, the license-holder can fulfill the responsibility established in the Radiation Protection Act of safe handling and disposal of a disused sealed source by handing it over to a producer.

J.1.2 Disused sealed sources and radioactive waste from medical use, research and industry

The licensee report to the SSM when a practice involving sources ceases (de-licensing) or when the holder of a particular source have transferred the ownership of the source to another licensee, sent it back to the manufacturer/producer or have scrapped the source (sent it for waste treatment). Table J1 shows the data for registration and de-registration of radioactive sources for the years 2009 and 2010. It can be noted that about 3 to 4 % of the sources are de-registered per year which amounts to about 200 sources per year.

Section J – DISUSED SEALED SOURCES

Registred sealed sources equipment

2009		2010	
Nuklid	No of sources	Nuclide	No of Sources
Am-241	43	Am-241	81
Am-241/Be	6	Am-241/Be	11
Au-198	1	C-14	4
Ba-137m	1	Cd-109	18
Br-82	2	Cf-252	7
C-14	3	Co-57	2
Cd-109	29	Co-60	304
Cf-252	9	Cs-137	576
Cm-244	3	Fe-55	16
Co-57	5	FeI	14
Co-60	381	Gd-153	3
Cs-137	710	H-3	22
F-18	2	Ir-192	5
Fe-55	42	Kr-85	29
FeI	25	Mo-99	1
H-3	14	Pb-210	1
Hg-203	2	Pm-147	17
Ir-192	3	Po-210	31
Kr-85	56	Pu-238	1
La-140	1	Ra-226	5
Na-24	3	Rb-86	1
Ni-63	2	Se-75	3
Pm-147	13	Sr-85	1
Po-210	118	Sr-90	15
Pu-239	1	U-235	1
Ra-226	3	Yb-169	1
Se-75	2	**Sum**	**1170**
Sr-90	9		
Tc-99m	1		
U-238	1		
Sum	**1491**		

Deregistred sealed sources equipment

2009		2010	
Nuclide	No of Sources	Nuclide	No of sources
Am-241	12	Am-241	17
C-14	1	Cd-109	1
Cd-109	14	Cm-244	1
Cf-252	1	Co-57	1
Co-60	71	Co-60	62
Cs-137	75	Cs-137	68
Fe-55	12	Fe-55	8
FeI	6	FeI	6
H-3	2	H-3	2
Ir-192	2	I-125	2
Kr-85	5	Kr-85	22
Pm-147	2	Pb-210	1
Po-210	13	Pm-147	6
Se-75	1	Po-210	2
Sr-90	6	Ra-226	1
Sum	**223**	Rb-86	1
		Sr-85	1
		Sr-90	2
		U-235	1
		Sum	**205**

Table J1: Registration and Deregistration of Radioactive Sources

Disused sealed sources to be disposed of are sent to Studsvik Nuclear AB (SNAB). SNAB is the only approved radioactive waste management facility in Sweden for handling radiation sources that need a license and currently receives approximately a little more than 200 sealed sources per year. However, SNAB is not required to accept, handle or dispose of disused sealed sources. The company operates on a commercial basis. Hence, problems may arise if the holder of a sealed source cannot afford the cost for the handling at Studsvik, or if Studsvik refuses to handle a sealed source.

After treatment, the disused sealed sources are stored by SNAB, pending disposal in disposal facilities for either short-lived low and intermediate level waste (SFR) or long lived low- and intermediate level waste (SFL).

SNAB receives approximately a little more than 200 disused sealed sources per year. Table J2 shows the inventory of disused sealed sources stored by SNAB, and table J3 shows the inventory of radioactive waste from medical use, research and industry stored by SNAB. The tables comprise all disused sealed sources and all radioactive waste delivered to SNAB between 2006-01-01 and 2010-12-31. SNAB is currently compiling an inventory on all disused sealed sources and ra-

dioactive waste from medical use, research and industry received between 1991 07 01 and 2005 12 31. This material has been conditioned together with nuclear waste and is now being stored in the interim storage facility for solid intermediate level waste, AM (see section D.1.4.2).

Nuclide	No of sources	Activity (Bq)	Estimated volume (litres)	Disposal
Am-241	504 000	2,02E+10	13 670 liter[1]	SFR
Am-241	383 290	2,19E+11	[2] *	SFL
Am-241	72	2,88E+11	*	SFL
Ba-133	6	2,06E+07	*	SFL
C-14	3	1,11E+07	*	SFL
Cd-109	4	1,86E+08	*	SFL
Cm-244	1	1,11E+09	*	SFL
Co-57	253	1,99E+10	*	SFL
Co-60	210	4,12E+12	*	SFL
Cs-137	293	2,95E+12	*	SFL
Fe-55	37	7,59E+10	*	SFL
H-3	12	6,01E+12	*	SFL
I-129	6	1,19E+07	*	SFL
Ir-192	11	2,60E+07	*	SFL
Kr-85	16	2,73E+11	*	SFL
Mn-54	1	7,40E+05	*	SFL
Na-22	1	7,40E+06	*	SFL
Ni-63	27	1,16E+10	*	SFL
Pm-147	31	1,52E+12	*	SFL
Po-210	2	9,00E+08	*	SFL
Ra/Be	1	3,70E+09	*	SFL
Ra-226	148	1,72E+11	*	SFL
Sr-90	55	2,50E+11	*	SFL
Tc-99	1	3,33E+05	*	SFL
Th-232	1	0,16E+06	*	SFL
Tl-204	1	3,70E+06	*	SFL

[1] Radiation sources from smoke alarms intended for households.
[2] Radiation sources from smoke alarms intended for the industry.
* The estimated net volume is 3 736 litres, see also Table D12.

Table J2: Inventory of disused sealed sources stored by Studsvik Nuclear AB 2010-12-31. The activity is the activity at the time of delivery.

Nuclide	No of waste consignments	Activity (Bq)	Estimated volume (litres)	Disposal
Am-241	11	1,05E+10	*	SFR
Ba-133	3	4,80E+07	*	SFL
Bi-207	8	4,25E+08	*	SFL
C-14	8	1,01E+09	**	SFL
Cl-36	2	1,02E+08	*	SFL
Co-57	26	1,19E+09	*	SFL
Co-60	15	1,88E+07	*	SFL
Cs-137	15	8,69E+08	*	SFL
Eu-152	1	2,00E+02	*	SFL
H-3	18	4,64E+07	**	SFL
I-125	58	1,02E+10	*	Allowed to decay to clearance levels
I-129	1	4,00E+04	*	SFL
I-131	1	8,80E+00	*	SFL
Kr-85	25	5,96E+09	*	Sent for recycling
Ni-63	4	2,20E+09	*	SFL
P-32	70	3,78E+08	**	SFL
Pm-147	2	1,35E+07	*	SFL
Ra-226	124	5,17E+08	*	SFL
S-35	16	4,59E+09	**	SFL
Sr-90	4	2,25E+08	*	SFL
Th-232	556 g	2,29E+06	*	SFL
Tl-204	1	4,00E+02	*	SFL
U-235	1885 g	1,51E+08	*	SFL
U-238	790 107 g	9,83E+09	*	SFL
Y-90	1	2,22E+05	*	SFL

* The estimated net volume is 3 736 litres, see also Table D11.
** Treatment: incineration.

Table J3: Inventory of radioactive waste stored by Studsvik Nuclear AB 2010-12-31. The activity is the activity at the time of delivery.

Orphan sources

License-holders are required to take all measures necessary so as not to allow for sealed sources to become out of regulatory control. On rare occasions orphan sources have been found. If the responsible license-holder cannot be identified, the State will provide financial resources for the management and disposal of the source. This is made possible through a special governmental funding arrangement that allows the SSM to use up to EUR 100 000 per year to cover the costs for the management and final disposal of orphan sources but also radioactive non-nuclear waste from past practices, e.g. radium and thorium products possessed by private persons.

J.1.3 Regulatory control

At research centers and hospitals inspections are planned and performed by SSM at regular intervals. The whole practice is inspected, also the routines for treatment of waste and the interim storage rooms for radioactive waste and sealed sources. Inspections at industries are infrequent due to the large number of facilities. The handling of disused sealed sources and back-end issues in general are usually brought to the notice of the SSM in connection with inquiries by licensees on these issues.

J.1.4 Conclusion

The Swedish Party complies with the obligations of Article 28. There is however ongoing work to improve administrative matters concerning the handling and disposal of disused sealed sources in a manner that is satisfactory from a radiation protection point of view.

K.1 Review of the license application for an encapsulation plant

SKB submitted a license application under the Act (1984:3) on Nuclear Activities for an encapsulation plant in November 2006. Extensive supplementary material was submitted in November 2009. The regulatory review of the application will be co-ordinated with the review of a license application for a disposal facility for spent nuclear fuel under the Act (1984:3) on Nuclear Activities and the Environmental Code (see also K.2). The licensing procedure is presented in section E.2.3.1.

K.2 Review of the license application for disposal of spent nuclear fuel

SKB submitted a license application under the Act (1984:3) on Nuclear Activities to establish a disposal facility for spent nuclear fuel at Forsmark, in the minucipality of Östhammar, 16 March, 2011. The regulatory review of the application will be co-ordinated with the review of a license application for the encapsulation plant under the Act (1984:3) on Nuclear Activities and the Environmental Code (see also K.1).
The licensing procedure is presented in section E.2.3.1.

K.3 License application for a disposal facility for decommissioning waste

SKB has initiated the consultation process to site a disposal facility for short-lived low and intermediate level decommissioning waste. The plan is extend the existing disposal facility for short-lived low- and intermediate level waste (SFR) to also accommodate decommissioning waste. SKB plans to submit applications under the Act (1984:3) on Nuclear Activities and the Environmental Code in 2013 and to have the disposal facility in operation in 2020.

K.4 Development of waste acceptance criteria for long-lived waste

Disposal of long-lived waste, e.g. core components, is planned to take place when decommissioning of most of the Swedish NPPs have been initiated. Long-lived waste therefore has to be kept in interim storage. Continued efforts are needed in order to establish proper acceptance criteria.

K.5 Effects from the Fukushima accident

The TEPCO Fukushima NPP nuclear accident has led to renewed risk and safety assessments in EU member states with nuclear power programmes. On May 12, 2011 the Swedish Government tasked SSM with carrying out a Swedish review, among other things entailing:

- To give a comprehensive, integrated report on the "stress tests" of concerned Swedish nuclear facilities which shall be conducted on the basis of the agreed common requirements within EU (as decided by the European Council on March 25, 2011 and to be conducted as approved by the European Nuclear Safety Regulator's Group on May 25).
- To report on the measures/actions which the nuclear industry has taken as a result of the "stress tests" until autumn 2012.

- Make an assessment of the effectiveness of the measures/actions which the industry has taken at that point.

SSM has close contact with STUK, Finland and other European authorities working with the "stress tests" in order to harmonize the procedures. The network set up by the Western European Regulators' Association (WENRA), where all European countries with nuclear power are members, is also important in this regard. The Swedish safety assessments include SKB and the interim storage for spent nuclear fuel at Clab at Oskarshamn.

K.6 Updated decommissioning plans

The decommissioning plans for the Swedish nuclear power plants will be updated and further detailed during the reporting period. This will give a better basis for planning, estimation of waste volumes and cost calculation.

LIST OF ABBREVIATIONS

ALARA	As Low As Reasonable Achievable (a principle applied in radiation protection)
ABT 1T	Waste container for transportation of long-lived low- and intermediate level waste
ACL	The Central Active Laboratory
AFS	The Swedish work environment authority regulations
AM	Interim storage for low and intermediate waste (Studsvik site)
AS 1-4	Waste storage facility (Studsvik site)
ASAR	As operated Safety Analysis Report
AT	Storage facility for solid intermediate waste (Studsvik site)
AU	Storage facility for radioactive waste (Studsvik site)
AV	Swedish work environment authority
BAT	Best Available Technique
BFA	Rock Cavern for Waste (Oskarshamn site)
BKAB	Barsebäck Kraft AB
BLA	Rock vault for concrete tanks (part of SFR facility)
BMA	Rock vault for intermediate level waste (part of SFR facility)
BNFL	British nuclear Fuel Ltd
BSS	Basic Safety Standards
BTF	Rock vault for low level waste (part of SFR facility)
BWR	Boiling Water Reactor
CHP	Combined Heat and Power
Clab	Centralt Lager för Använt Bränsle (Central interim Storage for Spent Fuel)
Clink	Integrated central interim storage facility and encapsulation plant
COGEMA	Compagnie Général de Matières Nucléaires
CONVEX	IAEA Convention Exercises
CTH	Chalmers Tekniska Högskola (Chalmers institute of Tecnology)
DG	Director General
ECURIE	European Community Urgent Radiological Information Exchange
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ENSREG	European Nuclear Safety Regulators' Group
EU	European Union
FA	Storage facility (Studsvik site)
FEP	Feature, Event and Process
FKA	Forsmarks Kraftgrupp AB
FR0-A	Treatment facility for radioactive non-nuclear waste (Studsvik site)
GDC	General Design Criteria
HA	Incineration facility (Studsvik site)
HCL	Hot cell laboratory (Studsvik site)
HELCOM	The Helsinki Commission
HERCA	Heads of European Radiation Control Authorities
HM	Treatment facility for intermediate level waste (Studsvik site)
HRL	Hard Rock Laboratory

LIST OF ABBREVIATIONS

IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiation Protection
ID	Evaporation facility (Studsvik site)
IGD-TP	Implementing geological disposal of radioactive waste technology platform
INES	International Nuclear Event Scale
INEX	OECD/NEA International Nuclear Emergency Exercises
INRA	International Nuclear Regulators' Association
IRRS	Integrated Regulatory Review Service
ISO	International Standard Organisation
KBM	Swedish emergengy management agency
KBS-3	Proposed method for disposal of spent nuclear fuel
KSU	KärnkraftSäkerhet och utbildning AB (the Swedish nuclear Training and Safety Center)
KTH	Kungliga Tekniska Högskolan (Royal institute of Technology)
LER	Licensee Event Report
LILW	Low and Intermediate Level Waste
LLW	Low Level Waste
MOX	Mixed oxide fuel
MSB	Swedish civil contingencies agency
MTO	Interaction between Man-Technology and Organization
NEA	Nuclear Energy Agency within the OECD
NGO	Non-Governmental Organisation
NKS	Nordisk kärnsäkerhetsforskning (Nordic Nuclear Safety Research)
NORM	Naturally Occurring Radioactive Materials
NPP	Nuclear Power Plant (including all nuclear power units at one site)
NR-MEG	Nuclear and Radiological Medical Expert Group
OECD	Organisation for Economic Co-operation and Development
OKG	Oskarshamns Kraftgrupp AB
OLC	Operational Limits and Conditions
OSPAR	Convention for the protection of the marine environment of the north-east atlantic
PHWR	Pressurised Heavy Water Reactor
PSAR	Preliminary Safety Analysis Report/ Preliminary Safety Report
PSR	Periodic Safety Review
PWR	Pressurized Water Reactor
QA	Quality Assurance
R&D	Research and Development
R0-A	Treatment facility for radioactive non-nuclear waste (Studsvik site)
RAB	Ringhals AB
RASK	SSM methodology for rapid response inspections
RD&D	Research, Development and Demonstration
RO	Reportable Occurrence
SAKAB	Company managing non-radioactive hazardous waste
SAMÖ-KKÖ	National emergency preparedness exercise in spring 2011

LIST OF ABBREVIATIONS

SAR	Safety Analysis Report/Safety Report
SFL	Disposal facility for long-lived low- and intermediate level waste
SFR	Disposal facility for short-lived low- and intermediate level waste
SFS	Swedish Code of Statutes
SKB	Swedish Nuclear Fuel and Waste Management Co
SKI	Swedish Nuclear Power Inspectorate
SMA	The melting facility (Studsvik site)
SMHI	Swedish Meteorological and Hydrological Institute
SNAB	Studsvik Nuclear AB
SoS	Swedish National Board of Health
SOU	State Official Report
SR-Site	The long-term safety assesment for the repository for spent fuel
SRV	Swedish Rescue Services Agency
SSI	Swedish Radiation Protection Institute
SSM	Strålsäkerhetsmyndigheten (Swedish Radiation Safety Authority)
SSMFS	SSM Code of Regulations
STUK	Finnish Nuclear and Radiation Safety Authority
TS	The tank and silo facility (Studsvik site)
TSO	Technical Support Organistation
UA	Waste storage facility (Studsvik site)
WENRA	Western European Nuclear Regulators Association
VLLW	Very Low Level Waste
WTD	Waste Type Description

Departementsserien 2011

Kronologisk förteckning

1. Olovlig fotografering. Ju.
2. Avskaffande av den obligatoriska byggfelsförsäkringen. M.
3. Högre utbildning i utvecklingssamarbetet
   En analys av högre utbildning inom ramen för svenskt utvecklingssamarbete och politiken för global utveckling. UD.
4. Behandling av personuppgifter vid Inspektionen för socialförsäkringen, m.m. S.
5. Barns rätt till vård och sociala insatser stärks. Ju.
6. Ökad konkurrens på det uppdragsarkeologiska området – vissa ändringar i kulturminneslagen. Ku.
7. Sekretess för finansiella företag. Fi.
8. Hotelltjänster. Ju.
9. Förbättringar inom familjepolitiken. S.
10. Preskription av rätt till försäkringsersättning m.m. Ju.
11. Enklare avbetalningsköp. Ju.
12. Genomförande av EU:s direktiv om skydd av djur som används för vetenskapliga ändamål. L.
13. Upphävande av lagen om exploateringssamverkan. S.
14. Synnerligen ömmande omständigheter och verkställighetshinder
    – en kartläggning av tillämpningen. Ju.
15. Utbyte av uppgifter ur kriminalregister mellan EU:s medlemsstater. Ju.
16. Kustbevakningsdatalag. Fö.
17. Sveriges företagande och konkurrenskraft
    – Internationell benchmarking. N.
18. Översyn av sjukförsäkringen – förslag till förbättringar. S.
19. Komplettering av kollektivtrafiklagen. N.
20. En reformerad yrkestrafiklagstiftning. N.
21. Vissa lagändringar i fråga om riktade emissioner av aktier. Ju.
22. Anmälningsskyldighet vid utstationering samt förtydligande avseende missbruk av visstidsanställningar enligt anställnings skyddslagen. A.
23. Uppdaterade högkostnadsskydd
    – öppen hälso- och sjukvård samt läkemedel. S.
24. Bättre tillgång till kommunala föreskrifter. Fi.
25. Godkännande av Europeiska rådets beslut om ändring av artikel 136 i EUF-fördraget
    – stabilitetsmekanism för euroländer. SB.
26. Domarnomineringar till internationella domstolar. UD.
27. Brottsbekämpande myndigheters tillgång till informationssystemet för viseringar (VIS). Ju.
28. EU:s gränskodex. Ju.
29. Översyn av myndighetsstrukturen för Sverige-, handels- och investeringsfrämjande.UD.
30. Genomförande av ändringsdirektiv 2010/84/EU avseende säkerhetsövervakning av läkemedel. S.
31. Vissa förenklingar i det arbetsmarknadspolitiska regelverket m.m. A.
32. Genomförandet av EU-direktivet om mänskliga organ avsedda för transplantation. S.
33. Rätten att få åldras tillsammans – en fråga om skälighet, värdighet och välbefinnande i äldreomsorgen. S.
34. Översyn av den statliga ersättningen till kommuner för mottagande av ensamkommande barn. Ju.
35. Sweden's fourth national report under the Joint Convention on the safety of spent fuel management and the safety of radioactive waste management.
    Swedish implementation of the obligations of the Joint Convention. M.

Departementsserien 2011

Systematisk förteckning

Näringsdepartementet

Kulturdepartementet

Arbetsmarknadsdepartementet

This page is intentionally left blank

Fritzes
ett Wolters Kluwer-företag

106 47 Stockholm Tel 08-598 191 90 Fax 08-598 191 91 order.fritzes@nj.se www.fritzes.se

ISBN 978-91-38-23635-2 ISSN 0284-6012