Ds 2008:73

Sweden's third 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

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Foreword

This report is issued according to Article 32 of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Sweden signed the Joint Convention September 29, 1997, the first day it was open for signing, during the ongoing General Conference at IAEA. The Convention was ratified about two years later, on July 29, 1999 and it entered into force on June 18, 2001.

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.
The first national report on the Swedish implementation of the obligations under the Joint Convention was issued in April 2003. The second national report was issued in October 2005. The reports were well received at the review meetings held 2003 and 2006, respectively.

A summary of highlights and issues raised about Sweden during the second review meeting 15-24 April 2006 can be found in section A 8. This section also includes an overview of those issues Sweden was asked to report about in its third national report (the present report). A summary of developments since the last national report can be found in section A9.

As was the case with the previous reports, the present report has been produced by a working group with representatives from the Swedish Nuclear Power Inspectorate (SKI), the Swedish Radiation Protection Authority (SSI), and the Swedish Nuclear Fuel and Waste Management Co (SKB). Before submission to the Government the report was sent for comments to other relevant authorities and the nuclear industry.

It should be stressed, however, that SKI and SSI were merged into a joint organisation, the Swedish Radiation Safety Authority, July 1, 2008. The new authority has been tasked with the responsibility and tasks from the Swedish Nuclear Power Inspectorate and the Swedish Radiation Protection Authority. More information in this regard can be found in section A.5.2. The formal procedure to process the national report did not allow for a proper account of the new organisational setting, as the transition period was not completed before the report had to be compiled. Thus, the report describes the situation as per June 30, 2008. Where applicable, the texts in the report have however been revised such that the division of responsibilities in the previous organisational setting are not emphasized.

This report constitutes an up-dated document with basically the same structure as the previous national reports under the Joint Convention. Section A provides an overview of the Swedish nuclear waste programme, including a brief historical review, in order to give the reader a background to the current status of the programme for the management of spent fuel and radioactive waste. Sections B 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 B 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.

The general conclusions about the Swedish compliance with the obligation of the Convention are reported in the executive summary.

List of abbreviations

ALARA	As Low As Reasonable Achievable (a principle applied in radiation protection)
ASAR	As operated Safety Analysis Report
BKAB	Barsebäck Kraft AB
BNFL	British Nuclear Fuel Ltd
BSS	The Basic Safety Standards Directive of the Euratom
BWR	Boiling Water Reactor
Clab	Centralt Lager för Använt Bränsle (Central Interim Storage for Spent Fuel)
COGEMA	Compagnie Général de Matières Nucléaires
CTH	Chalmers Tekniska Högskola (Chalmers Institute of Tecnology)
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
FKA	Forsmarks Kraftgrupp AB
GDC	General Design Criteria
ICRP	The International Commission on Radiation Protection
INES	The IAEA/NEA International Nuclear Event Scale
KSU	KärnkraftSäkerhet och Utbildning AB (the Swedish Nuclear Training and Safety Center)
KTH	Kungliga Tekniska Högskolan (Royal Institute of Technology)
LER	Licensee Event Report
LLW	Low Level Waste
LILW	Low and Intermediate Level Waste
MTO	Interaction between Man-Technology and Organization
NEA	Nuclear Energy Agency within the OECD
NKS	Nordisk kärnsäkerhetsforskning (Nordic Safety Research)
NPP	Nuclear Power Plant (including all nuclear power units at one site)
OLC	Operational Limits and Conditions
OECD	Organisation for Economic Co-operation and Development
OKG	Oskarshamns Kraftgrupp AB
PSAR	Preliminary Safety Analysis Report
PSR	Periodic Safety Review
PWR	Pressurized Water Reactor
QA	Quality Assurance
RAB	Ringhals AB
R&D	Research and Development
SAR	Safety Analysis Report
SFR-1	Repository for Operational Waste
SKB	Swedish Nuclear Fuel and Waste Management Co
SKI	Statens kärnkraftinspektion (Swedish Nuclear Power Inspectorate)
SKIFS	Statens kärnkraftinspektions författningssamling (the SKI Code of Regulations)
SSI	Statens strålskyddsinstitut (Swedish Radiation Protection Authority)
SSI FS	Statens strålskyddsinstituts författningssamling (the SSI Code of Regulations)
VLLW	Very Low Level Waste
WENRA	Western European Nuclear Regulators Association
WTD	Waste Type Description

Executive Summary: General Conclusions

Article 32 of the Joint Convention calls for a self-assessment by each Contracting Party regarding compliance with the obligations of the Convention. This self-assessment should be reported in the National Report to the Review Meetings. Sweden's self-assessment has demonstrated compliance with all the obligations of the Convention, as shown in detail in sections B to J of this report.

The Swedish existing nuclear power programme is since a few years under strong development. Large amounts are being invested in the 10 remaining operating reactors to prepare for long term operation and major programmes are going on to upgrade and uprate the plants.

The former regulatory authorities, the Swedish Nuclear Power Inspectorate (SKI), and the Swedish Radiation Protection Authority (SSI), was merged into a new regulatory body, the Swedish Radiation Safety Authority, July 01, 2008. The new authority has been tasked with the responsibility and tasks from SKI and SSI.

These developments create new challenges for the safety work of the licensees as well as for the regulatory authority.

Even though comprehensive and very active programmes for the management and disposal of spent fuel and radioactive waste have been established, many challenges remain. Over the next 5-15 years several new facilities will be sited, constructed and taken into operation, e.g. an encapsulation plant and a repository for spent fuel. These activities will require substantial efforts for both the nuclear industry and the regulatory bodies.

The generally positive impression reported to earlier review meetings under the Joint Convention still stands. Therefore, Sweden would like to point out the following as strong features in its national nuclear practice:

- The responsibility for safety is clearly defined in the Swedish legal framework. In order not to dilute the responsibility of the licence holders, the Swedish regulations are designed to define requirements to be achieved, not the detailed means to achieve them. Within the framework given by the regulations, the licence holders have to define their own solutions, and demonstrate the safety level achieved to the regulatory bodies.
- The legislation clearly defines that all licence holders are responsible for the safe handling and disposal of spent fuel and radioactive waste, as well as for the decommissioning and dismantling of facilities.
- The operators of nuclear power plants must jointly carry out the research and development activities needed to ensure the safe handling and disposal of spent fuel and radioactive waste, as well as for the decommissioning of facilities. The R&D programme is presented to the Government regularly and is subject to regulatory review.
- The licensee of a nuclear facility which generate or has generated residual products must pay a fee to the Nuclear Waste Fund, which is subject to regulatory supervision, to ensure that resources are available for the handling and disposal of spent fuel and radioactive waste, and for the decommissioning and dismantling of the facilities.
- The legislation provides for public insight into the activities of the licensees and also provides an opportunity for stakeholders to receive financial support to participate in the ongoing consultations process to site a repository for spent nuclear fuel.
- The regulatory bodies have maintained and increased their resources and are further developing their regulatory practices. There is an open and generally constructive relationship between the regulatory bodies and the licence holders.

Sweden also wishes to mention that there are areas in which improvements to the national waste management system are needed:

- The merger of SKI and SSI will pose challenges with regard to integrating the organisations and the regulatory practices.
- The resources of the regulatory body need to be strengthened in order to cope with the expected work load during the coming years.
- The implementation of the changes to the financing system as well as the regulatory review procedures related to the financing system need to be improved and modernised.

Sweden is looking forward to reporting on this in its 2012 national report to the Joint Convention.

Section A - Introduction

A.1 Summary

Spent fuel in Sweden emanates mainly from four commercial nuclear power plants, one material testing reactor and one research reactor. 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.

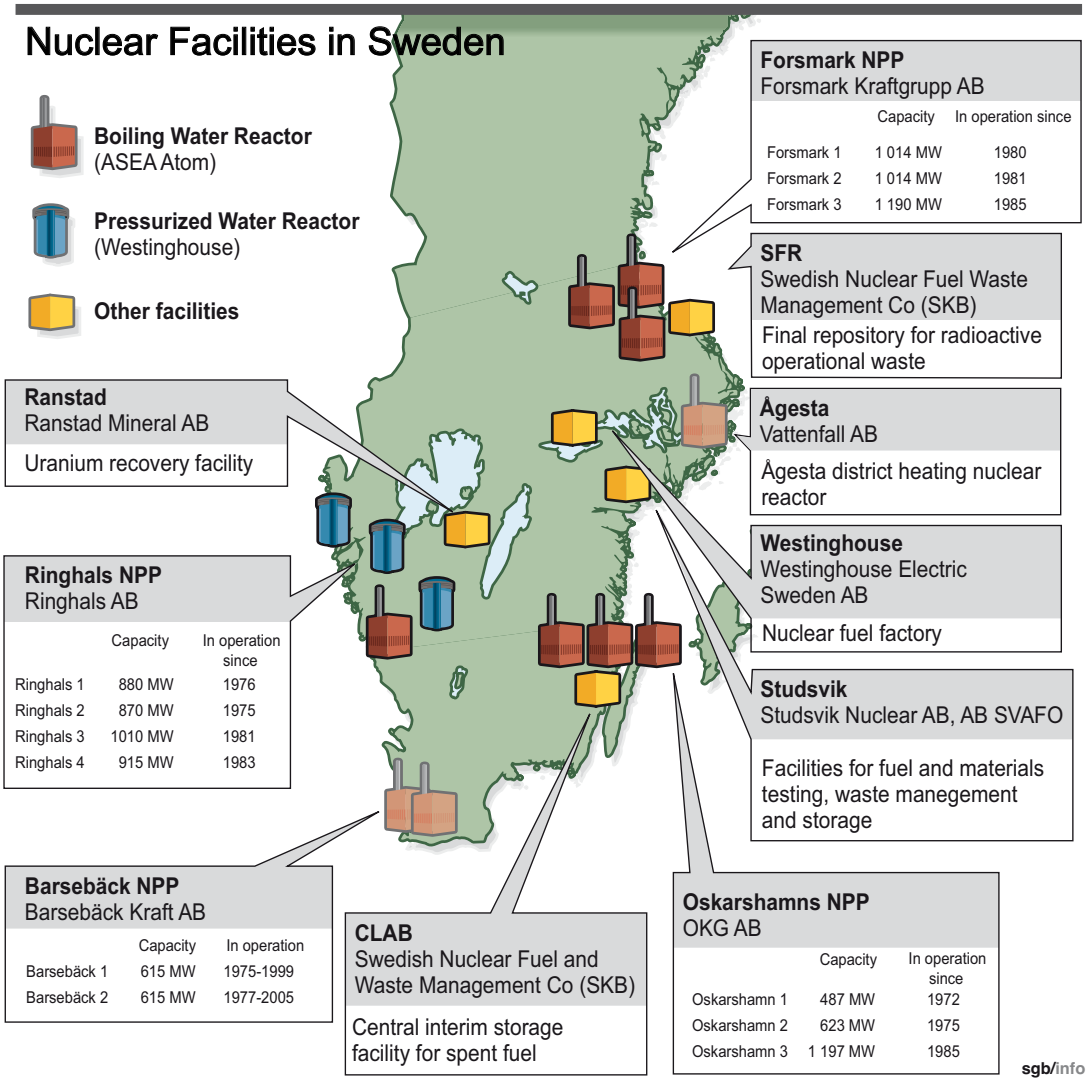

Figure A1: Nuclear facilities in Sweden.

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.

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 repository in crystalline bedrock (SFR-1).

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.

The locations of existing nuclear facilities in Sweden are shown in Figure A1.

A.2 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 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.

A.3 Historical and political development

A.3.1 Past practices

No formal requirements for the management of spent fuel and nuclear waste were established in Sweden until the late 1970's. A study was initiated in the mid-1990's with the objective to understand past practices regarding management of radioactive waste better. 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).

A.3.2 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, 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, 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 100 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 repository for vitrified waste and Germany did not have to build a repository for used MOX-fuel. The used MOX-fuel from Germany is now stored in the Clab facility.

A.3.3 The 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 and the plans to acquire nuclear weapons were abandoned.

A.3.4 Development of the waste management strategy

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 report from the committee was submitted in 1976 and has to a great extent influenced subsequent developments. 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 program 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 repository for low- and medium level radioactive waste should be established.

A.3.5 The research - and development (R&D)program

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 R&D-programme to be submitted for regulatory evaluation was established in 1984 when the Act on Nuclear Activities was promulgated. Since 1986 SKB has produced eight R&D programmes with KBS-3 as the main alternative for the disposal of spent fuel. At present SKB is in the process of finalising site investigations in two municipalities. The authorities are engaged in the Environmental Impact Assessment (EIA) in connection with the siting process.

A.4 The Swedish management system for spent nuclear fuel and nuclear waste

A.4.1 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 (research reactor, hot-cell and waste treatment facilities) and, to a limited extent, at Westinghouse Atom AB's fuel fabrication plant.

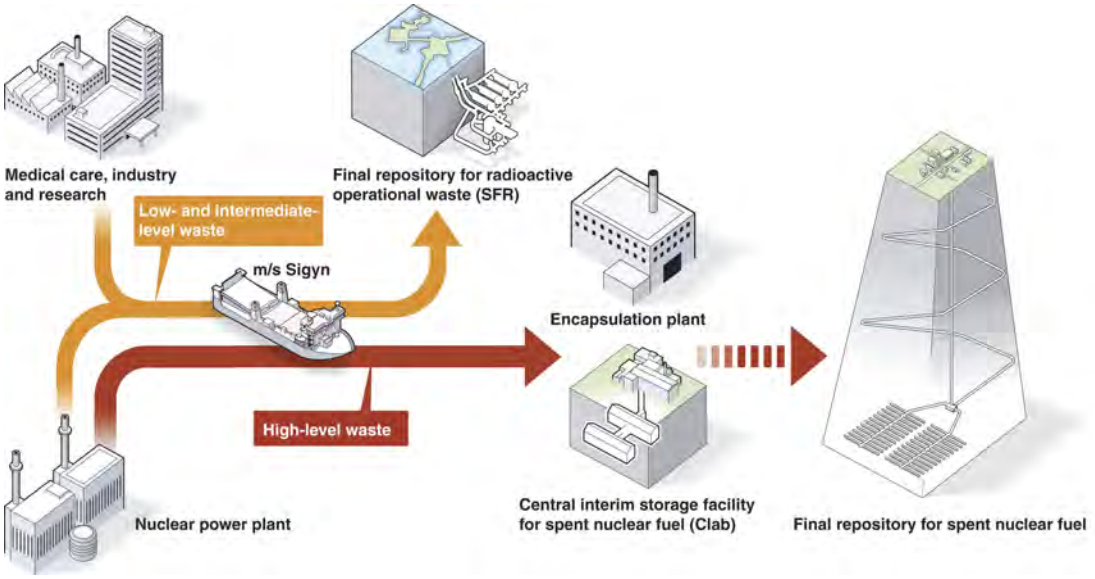

Figure A2: Management system for spent fuel and nuclear waste as presented in RD&D-program 2007.

In total the Swedish nuclear power programme will generate approximately 19 000 m^3 spent fuel, 60 000 m^3 low and intermediate level waste (LILW), and 160 000 m^3 decommissioning waste (based on 40-year operation of each reactor). The typical total annual production of LILW at the nuclear facilities is 1 000-1 500 m^3.

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.

A.4.1.1 Existing Spent Nuclear Fuel Management Practices

Management practices at the NPP sites

Spent nuclear fuel from the nuclear power reactors is temporarily stored in 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 repository.

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 at the Oskarshamn nuclear power plant. The fuel is stored in water pools in rock caverns 25 m deep in the bedrock.

Construction started in 1980 and it was taken into operation in 1985 with a storage capacity of 5000 tonnes of spent fuel. Clab has recently been expanded with a second rock cavern with water pools. The extended part of the facility was taken in operation in the beginning of 2008. The current total storage capacity is approximately 8 000 tonnes of spent fuel, and 4 676 tonnes were being stored at the end of 2007.

A.4.1.2 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 (scrap metal).

Repository for radioactive operational waste, SFR-1

SFR-1 is a repository for LILW resulting from the operation of Swedish nuclear reactors. In addition small amounts of radioactive waste from hospitals, research institutions and industry are disposed of in SFR-1.

SFR-1 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 31 768 m^3 had been used by 2007-12-31.

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

Clearance is an important component in the waste management system. 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 500 tonnes of melted scrap metal (<500 Bq/kg) were cleared for recycling.

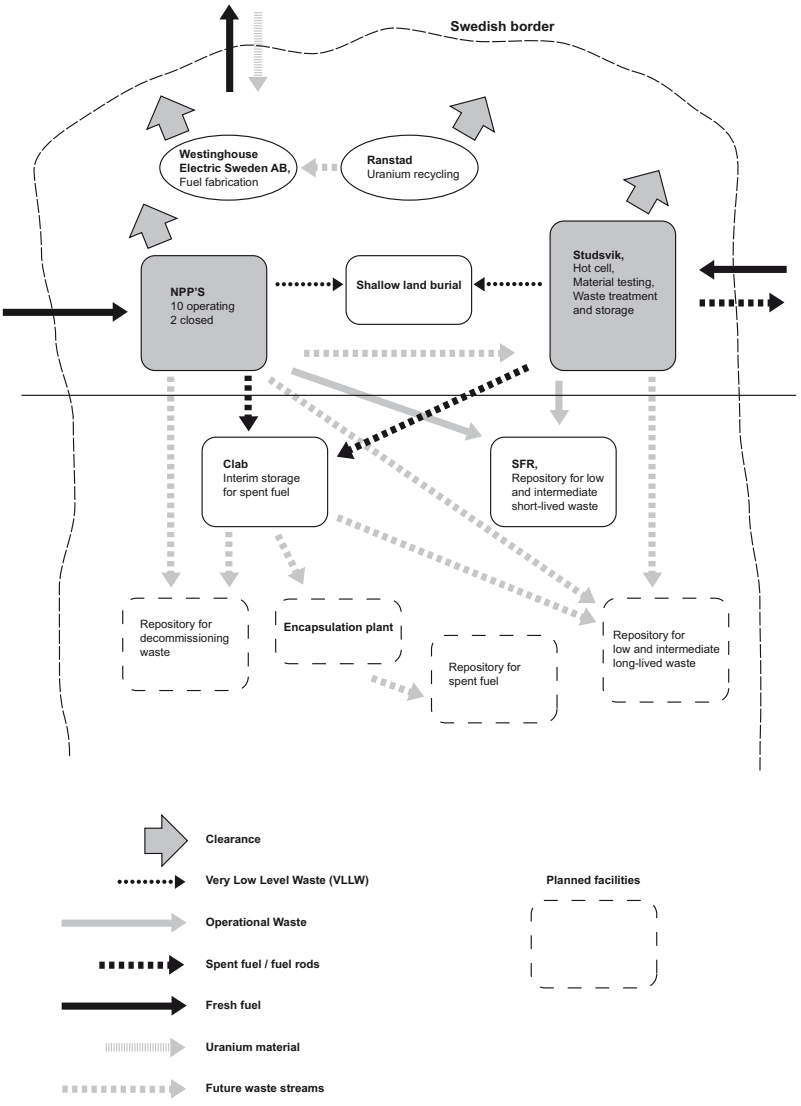

Figure A3: Materials and waste streams in the Swedish nuclear cycle.

A.4.2 Planned facilities and siting

A.4.2.1 General

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

A.4.2.2 The Spent Nuclear Fuel Program

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 in individual deposition holes at a depth of 400-700 m in the bedrock.

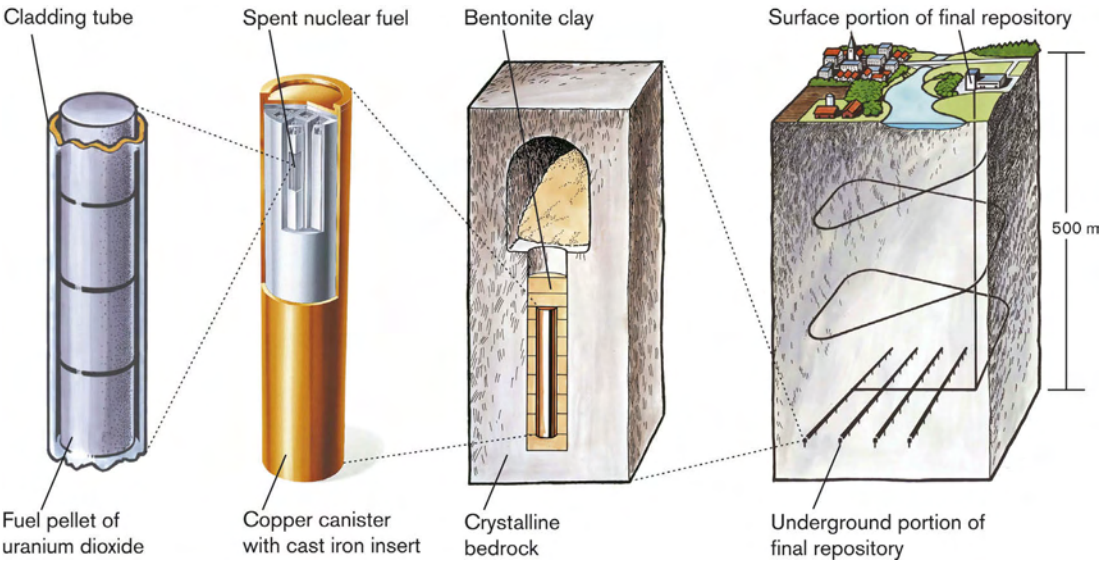

Figure A4: The reference method KBS-3 for disposal of spent nuclear fuel as presented in RD&D-program 2007.

Encapsulation plant for spent nuclear fuel

SKB submitted a license application under the Nuclear Activities Act for an encapsulation plant in November 2006. SKB at the same time announced that extensive supplements were planned to be submitted in the end of 2008.

The time schedule for encapsulation of the spent nuclear fuel has been developed by SKB, and the following sequence of events is proposed:

2008/2009	Submission of supplementary material to the license application for siting and construction
2012-2020	Construction and commissioning, including inactive trial operation
2019	Submission of application for operation
2020	Active trial operation, followed by operation

Repository for spent nuclear fuel

In the early 1990's SKB initiated an active programme for siting a spent nuclear fuel repository. SKB's time schedule for disposal of the spent nuclear fuel is:

2005-2009	Site investigations, presently at two sites, which include surface based investigation from deep bore holes
2010	Submission of license application for siting and construction
2012-2020	Detailed site characterisation and construction
2019	Application for initial operation
2020	Start of waste emplacement

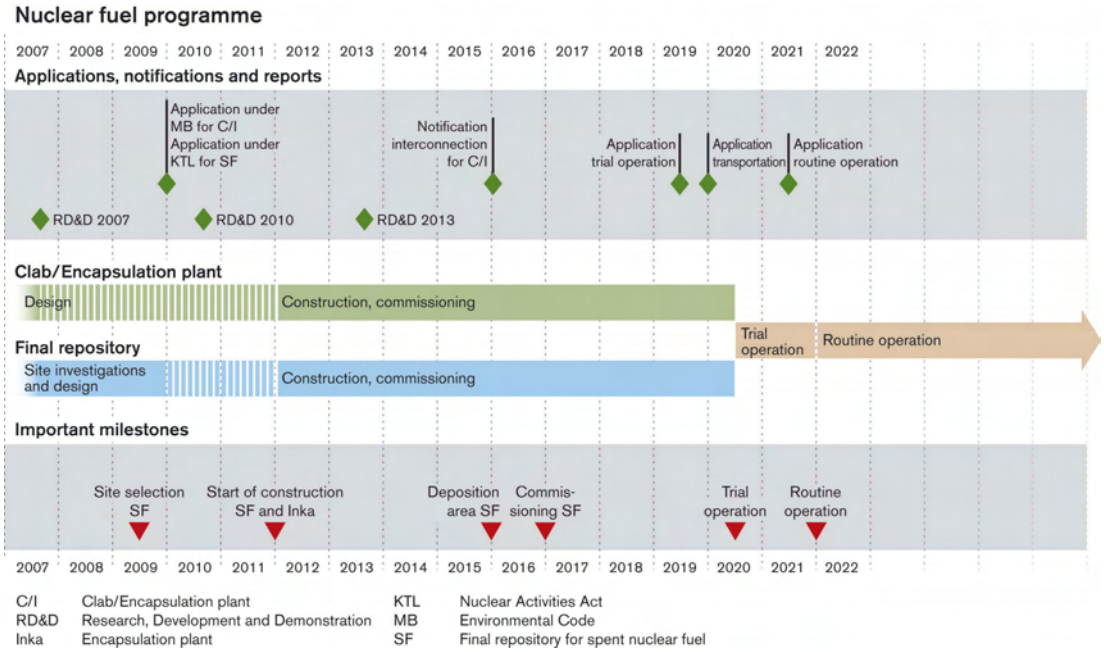

Figure A5: SKB`s time schedule for the nuclear fuel programme as presented in RD&D-program 2007.

Research and demonstration facilities

The Äspö Hard Rock Laboratory
An important step in the repository development programme was the construction of the Äspö hard rock laboratory in the 1990's. The laboratory is situated close to the Oskarshamn nuclear power plant at a depth of 460 meter. At the laboratory methods are developed and tested for such things as site characterisation, deposition and retrieval of canisters, as well as methods for excavation of tunnels and shafts. A layout of the facility is presented in figure A6.

The Canister Laboratory
In 1998 a canister laboratory was commissioned. It is mainly used for development of welding techniques and methods for non-destructive testing of canisters and welds.

The Bentonite Laboratory
In 2007 a bentonite laboratory was inaugurated, co-located to the Äspö-laboratory. The bentonite laboratory will make it possible to conduct large-scale tests of the properties of the bentonite and to further develop the industrial handling process.

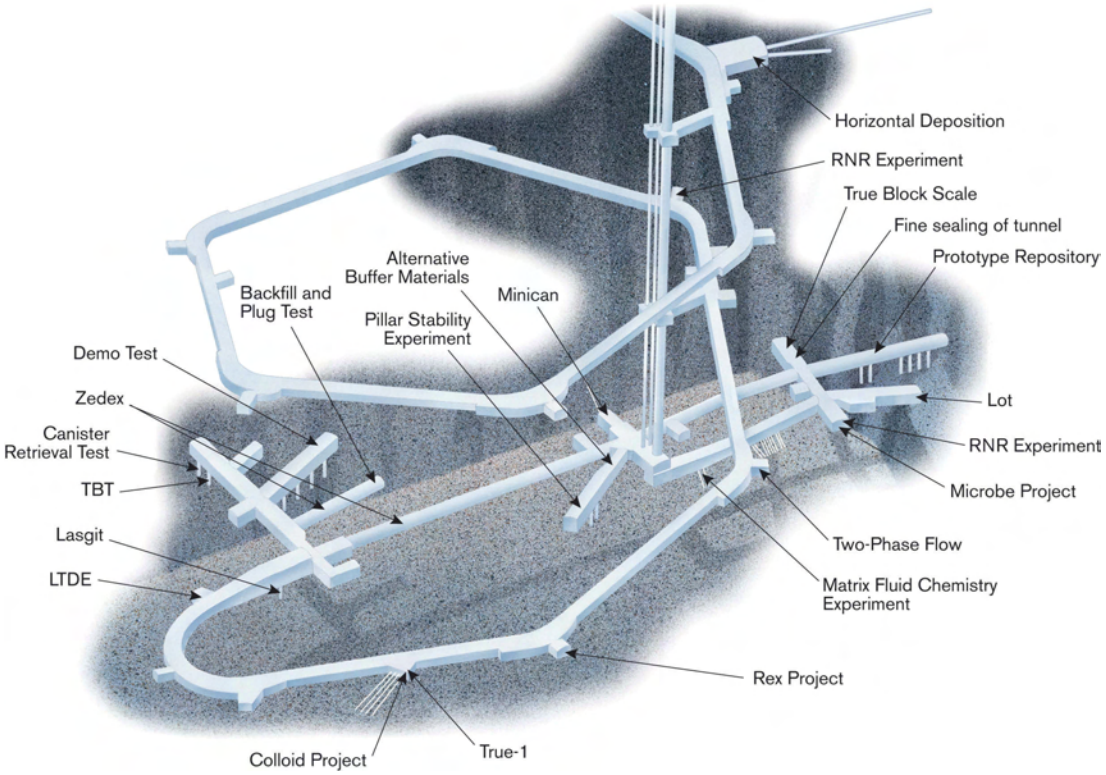

Figure A6: Layout of the Äspö Hard Rock Laboratory as presented in RD&D-program 2007.

A.4.2.3 The Low- and Intermediate Level Waste (LILW) Program

Repository for short-lived low and intermediate level decommissioning waste

SKB plans to dispose of waste from the future decommissioning of the nuclear power plants in an extension to SFR-1. SKB intends to submit a license application in 2010 and operation is planned to commence in 2020.

Repository for long-lived low and intermediate level waste

According to current plans, a repository 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, core-components and certain internal components from nuclear power reactors. The waste is currently stored at Studsvik, the nuclear power plants and Clab.

Dry interim storage of long-lived waste

Preliminary plans to construct a special central interim storage for long-lived long-lived low and intermediate level waste have changed. Instead, preparations are under way for dry storage of long-lived low- and intermediate-level waste from all nuclear power plants in BFA (rock cavern for waste) in Simpevarp. OKG is already using BFA for dry interim storage.

The BFA facility has been licensed according to the Environmental Code for storage of long-lived waste from also other nuclear power plants then OKG, and a new waste container is under development. Transports of long-lived waste from other NPP's are planned to start in 2011 provided that an updated safety report has been approved by the regulatory authorities.

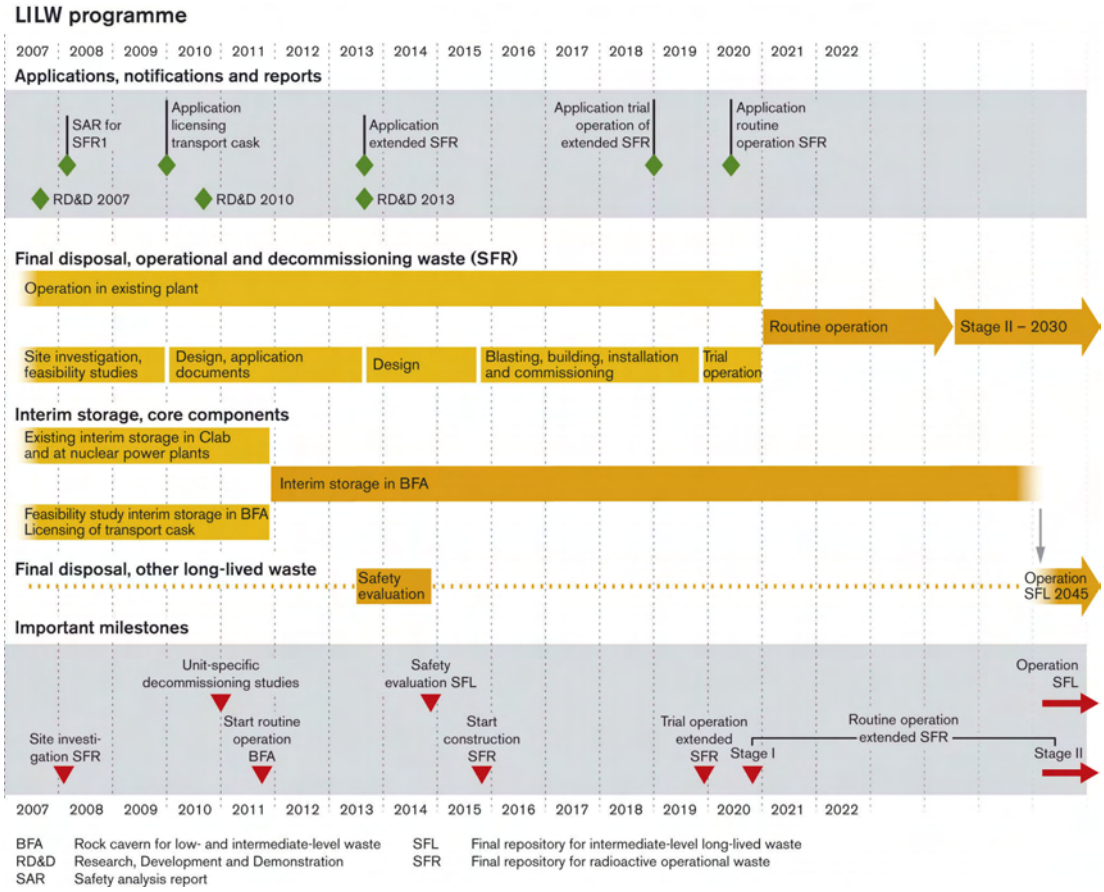

Figure A7: SKB`s time schedule for the LILW programme as presented in RD&D-program 2007.

A.5 Legal and regulatory framework

A.5.1 The main legislative instruments

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 Financing of 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.

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 Financing of 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 great 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 authorities.

A.5.2 The regulatory authority

Different from the situation in many nuclear countries, Sweden has had two separate regulatory authorities supervising nuclear activities. The Nuclear Power Inspectorate (SKI) has been responsible for reviewing and supervising nuclear safety and the Radiation Protection Authority (SSI) has been responsible for reviewing and supervising radiation protection. Their missions and tasks have been basically the same since the beginning of the nuclear programme.

On several occasions organisational changes have been discussed but not decided. It has been seen as an advantage that two independent authorities, each from its own viewpoints, review and supervise the nuclear industry. At the same time there has been some overlap in regulations and from time to time some friction between the two authorities.

The Government, however, announced in April 2007 that they intended to merge SKI and SSI into a new authority, and that the new authority should be tasked with the same responsibilities and tasks as the two earlier authorities. Several motives were presented for this move:

- a general ambition by the Government to reduce the number of authorities and make civil service more efficient
- a more efficient use of common resources for supervision of nuclear facilities
- an integrated competence within nuclear safety and radiation protection will lead to a reinforced supervision of both nuclear and non-nuclear activities
- inspections will benefit from an integrated perspective
- it will be easier for the licensees and other stakeholders to deal with only one regulatory body, the risk for contradictory rules and decisions will be eliminated
- Sweden will be more clearly represented in international contexts of nuclear safety and radiation protection

The date for the merger was set to July 1, 2008. One of the main reasons was that the new authority would be organised and in place well before the licensing of a final repository for spent fuel.

A special investigator was appointed in September 2007, to propose the new organisation, legal changes and other necessary measures. The investigator was expected to head the new authority that should be located to the Stockholm area. The merger was not expected to generate any large economical savings since the regulatory activities of the previous regulatory activities (SKI and SSI) would be preserved.

In addition to the required changes to the legislation as a consequence of the merger, the investigator identified the need for a more thorough review of the legislative framework related to nuclear activities. The investigator therefore suggested to the Government in March 2008, to initiate a special investigation to identify improvements to the regulatory framework. The investigator specifically pointed out the need for a review in the following areas:

- the legal-technical division between nuclear safety and radiation protection
- the concepts of nuclear safety and radiation protection
- the legal-technical division between nuclear waste and radioactive waste
- sanctions according to the nuclear activities act
- regulatory control according to the Environmental Code
- the statutes of the Euratom Treaty as regards safeguards and control of transport of radioactive waste

The new authority, the Swedish Radiation Safety Authority, was established July 1, 2008, and is responsible for enforcing compliance with the nuclear safety and radiation protection legislation. The new authority has been tasked with the responsibility and tasks from the former regulatory authorities SKI and SSI.

One of the main tasks for the new authority, as specified in the letter of appropriation from the Government, is to develop a strategic national waste management plan comprising both nuclear and non-nuclear waste management practices. The plan should describe strategies and goals for the management and disposal of all types of radioactive waste. The plan, to be submitted to the Government not later than June 30, 2009, should give an account for e.g. existing management and disposal practices as well as all parties involved in radioactive waste management and their respective roles and responsibilities. The plan should also elucidate possible problems related to existing management practices, and identify areas of concern where further actions need to be taken.

This national report, the third Swedish national report under the Joint Convention, accounts for the developments until June 30, 2008. Thus, the report describes essentially the organisational setting and regulatory framework existing before the new regulatory body was established. Some very basic information on the new organisational structure can be found in figure A8, below. More detailed information can be found on the new authority's web-site: www.ssm.se

Sweden will provide information about further development in this regard at the review meeting, and in its 2012 national report to the Joint Convention.

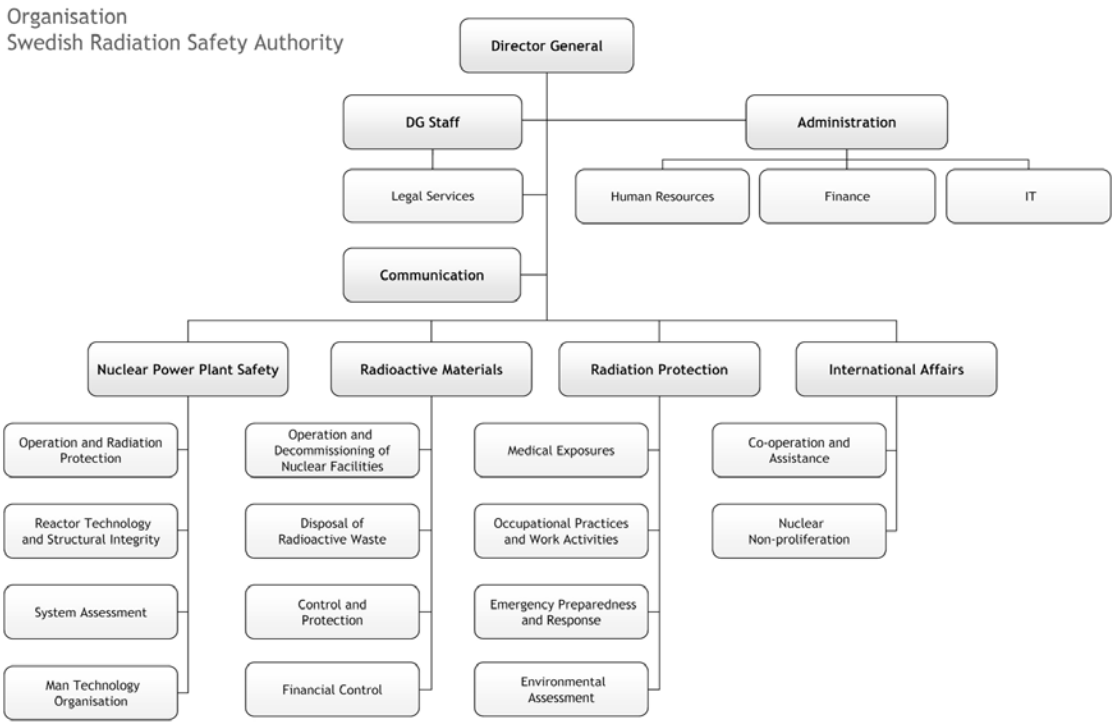

Figure A8: The organisation of the new Swedish Radiation Safety Authority.

A.5.3 The National Council for Nuclear waste

The National Council for Nuclear Waste was established in 1985 and is an advisory body to the government on matters related to nuclear waste management. The Council is since 1992 an independent committee attached to the Ministry of the Environment.

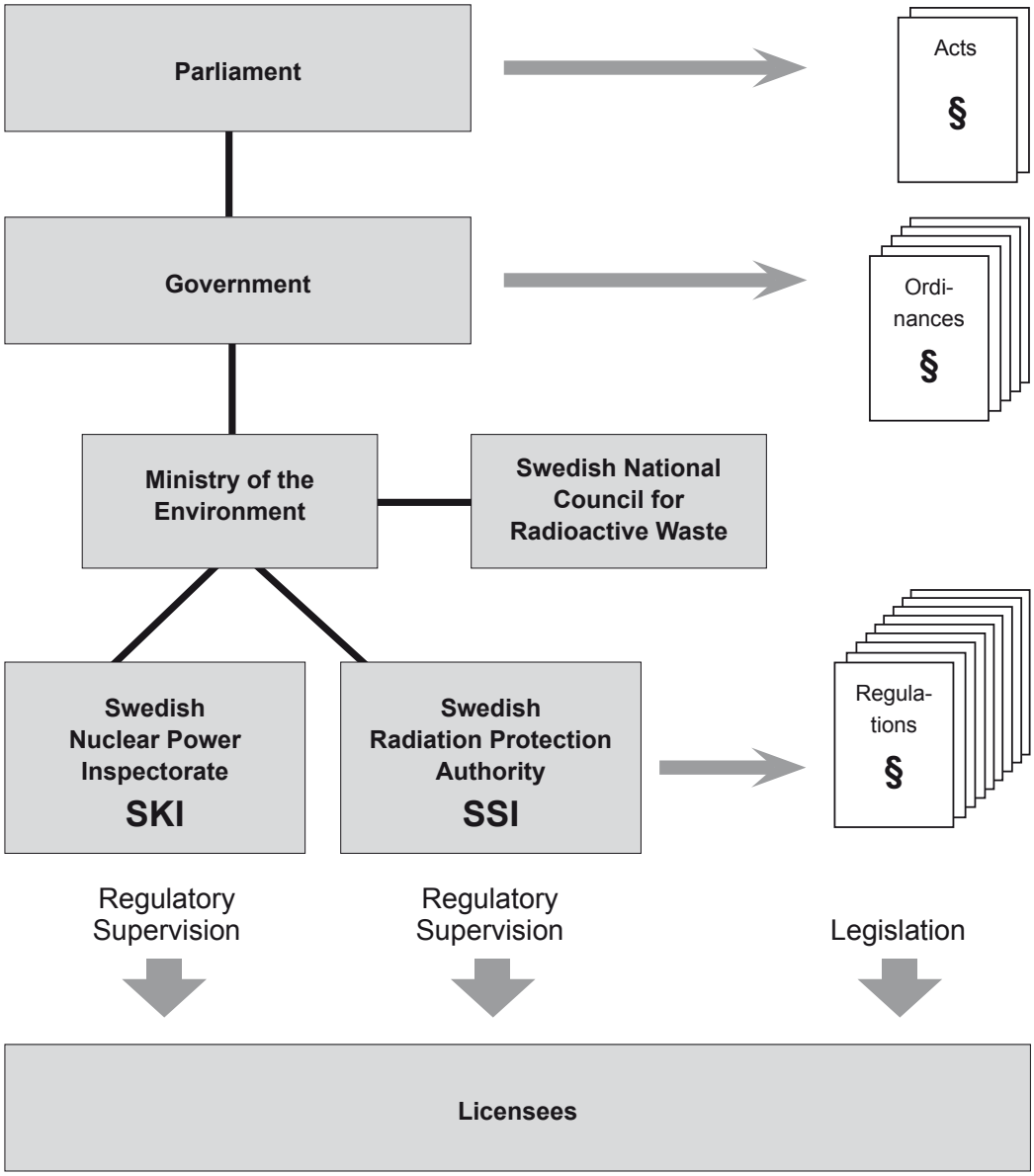

Figure A9: Organisational structure for nuclear safety and radiation protection regulatory control.[1]

A.6 Costs for management of spent nuclear fuel and radioactive waste

A.6.1 The financing system

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.

[1)] SKI and SSI was July 1, 2008, merged into The Swedish Radiation Safety Authority. The new authority has been tasked with the responsibility and tasks from the former regulatory authorities SKI and SSI.

The basic requirement stipulates that the holder of a licence for a nuclear facility which generate or has generated residual products must pay a fee to the Nuclear Waste Fund, to cover the licensee's share of the total costs for the management and disposal of spent nuclear fuel and/or nuclear waste. The regulatory authority appointed by the Government reviews the cost calculations and submits a proposal for the size of the fees to the Government. The size of the fee is decided by the Government for each year and is individual for each utility. The purpose of the Fund is to cover all expenses incurred for the safe handling and disposal of spent nuclear fuel, as well as dismantling nuclear facilities and disposing of the decommissioning waste. The Fund must also finance SKB's R&D.

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.

The final report from the Committee[2] was submitted to the Government in December 2004. As a result of the review the Act (1992:1537) as well as the Ordinance (1981:671) on the Financing of Future Expenses on Spent Nuclear Fuel etc. has been replaced by the Act (2006:647) and the Ordinance (2008:715) on Financing of 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 reactor owners 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 should be based on 25 years of operation).
- The licensee of nuclear facilities other than nuclear power reactors shall base cost estimates and the build up 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.

A.6.2 Payments to the Nuclear Waste Fund

The licensee of a nuclear facility which generate or has generated residual products must pay a nuclear waste fee. The fee shall cover the licensee's share of the total costs for the management and disposal of spent nuclear fuel and/or nuclear waste. 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 on the condition that 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 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 fee varies from year to year and is individual for each utility. Between 1982 and 1996 the average fee was SEK 0.019 per kilowatt-hour but has since then been gradually lowered. The average fee is currently SEK 0.005 per kilowatt-hour (2008) 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.

A.6.3 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 management of the Nuclear Waste Fund is the responsibility of a separate government agency, the Nuclear Waste Fund.

A.6.4 Current cost estimates

The estimated total future cost, from 2008 onwards is approximately SEK 42[3] billion (equivalent to 1000 millions). The sum of the future expenses and of those already accrued on various nuclear waste projects, are approximately SEK 69 billion.

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[2] Commission report on the review of the Financing System (SOU 2004:125), December 2004 (in Swedish).

[3] The figure is based on an average time of 40 years for all nuclear power reactors.

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.

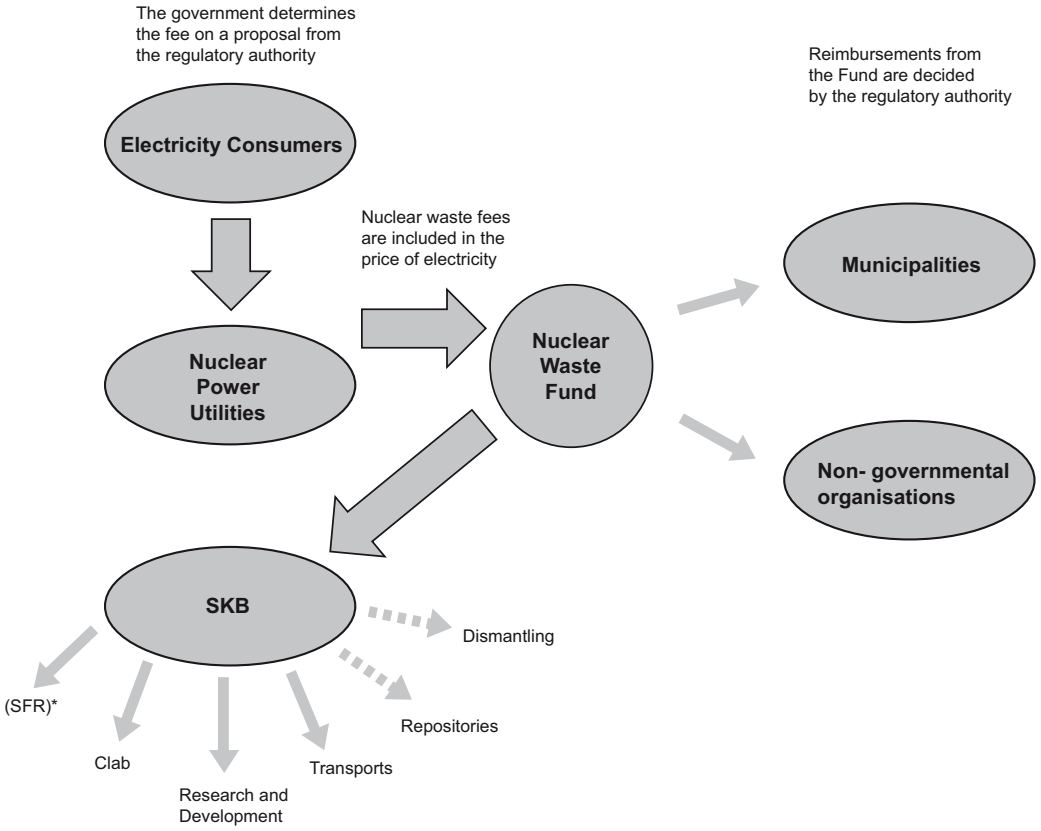
The Nuclear Waste Fund will eventually cover expenses for:

- the encapsulation of spent nuclear fuel;
- the repositories for spent nuclear fuel and long-lived low and intermediate level waste;
- the dismantling of nuclear power plants and the disposal of decommissioning waste;
- continuing research and development work; and
- the expenses for regulatory control and supervision after closure of the reactors.

The repository for radioactive operational waste (SFR-1) has been paid for by the nuclear power utilities and not by the Fund. Costs for management of operational waste are paid for directly by the nuclear power utilities.

A.6.5 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 Studsvik Act (1988:1597). 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 dismantling these facilities. According to estimates, SEK 1.7 billion will be needed up to the year 2030 to meet these expenses. The special fee is the same for all four nuclear power utilities, currently SEK 0.003 per kilowatt-hour, which has been reassessed each year based on a proposal by SKI. 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 Nuclear Activities Act, the Parliament also decided that the Studsvik Act should be cancelled by December 31, 2009.



*) Costs for SFR are paid for directly by the nuclear power utilities.

Figure A10: Flow of funds in the financing system as regards nuclear power utilities.

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

A.7.1 Regulatory activities[4]

SKI and SSI

Important international work for the regulatory authorities follows as a consequence of the Swedish ratification of international conventions and having signed bilateral and multilateral agreements. In these cases the Government often assigns the task of providing expert knowledge and fulfilling Swedish obligations to the authorities.

In addition, international sharing of efforts and results is considered as crucial by Sweden for efficient regulatory work. Sweden considers it important that national regulatory programmes are open to international scrutiny and peer review, since these mechanisms provide a form of quality assurance.

For these reasons SKI has participated actively in a number of IAEA[5], OECD/NEA[6], and EU[7] committees and working groups. SKI has also been a member of INRA[8] and WENRA[9]. Senior experts from SSI have been active participants in, for example, the ICRP[10], the OECD/NEA, IAEA, EU committees and working groups, and the UNSCEAR[11].

Both SKI and SSI have held bilateral agreements with the corresponding authorities in a number of countries, e.g. the Nordic Countries, Canada, France, Japan, Lithuania, the Russian Federation, South Africa, Spain, United Kingdom, and USA.

SKI's and SSI's international engagement has not been limited to regulatory issues but also includes participation in international research projects. Most of these projects are within EU's research programme, OECD/NEA and the IAEA.

The international activities have been very extensive in the fields of nuclear safety and radiation protection. Even if the activities are generally regarded as important, SKI and SSI have constantly had to prioritise their participation, because of limited staff resources. Cases, where the tasks are directly regulated by conventions or special agreements signed by Sweden, have had the highest priority. Participation in standing groups of international organisations has also been given high priority.

A.7.2 SKB

SKB also gives international co-operation high priority, and has signed bilateral agreements with corresponding organisations in 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 organisations. SKB is currently participating in 6th Framework Programme and has actively proposed areas for future research and development in the 7th Framework Programme.

The cooperation with Posiva in Finland has been extended and comprises projects in the fields of repository technology, site investigation and encapsulation techniques.

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

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4) As a consequence of the merger of SKI and SSI the responsibilities, as regards participation in international activities, has been transferred to the Swedish Radiation Safety Authority.
5) The International Atomic Energy Agency
6) The Nuclear Energy Agency within the Organisation for Economic Co-Operation and Development
7) The European Union
8) International Nuclear Regulatory Association
9) Western European Nuclear Regulators Association
10) The International Commission on Radiological Protection
11) The UN Scientific Committee on the Effects of Atomic Radiation

A.7.3 SKI's and SSI's International support programs[12]

SKI has since 1992 received a special grant from the Government for co-operation with Eastern and Central Europe in the area of nuclear safety and waste management. The task was organised as a project unit, the Swedish International Project Nuclear Safety (SIP), within SKI to administer and manage this work. From 2005 the name was changed to SKI International Co-operation Programme (ICP). The radiation protection support, which also deals with radiation protection outside the nuclear power sector, has been handled by SSI's department for International Development Co-operation (SIUS) since 1991.

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 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.

Through this co-operation, all relevant organisations in the recipient country receive support so as to strengthen the entire nuclear infrastructure. These organisations include nuclear power plants, ministries, regulatory authorities and technical support organisations.

SIP's/ICP's was for some time focused on improving the safety and organisation at the Ignalina nuclear power plant, as well as on support for the development of the Lithuanian regulatory authority. Support has also been directed towards radioactive waste management and the preparation of the decommissioning of Ignalina's Unit 1. The total support to Lithuania during the period 1992-2007 amounted to SEK 441 million.

In spring 2001, the Swedish Parliament took a decision to change the future direction of the nuclear safety support. When Lithuania became a member of the EU, the Swedish cooperation with Lithuania was transformed into a regular cooperation on the same conditions as with other countries within the EU and the focus for nuclear safety support was shifted to north-west Russia.

Since 1996, SIP's/ICP's support has also included Russia, where co-operation in the area of nuclear safety was initiated with the Leningrad nuclear power plant. In 1998, SIP/ICP started the assistance programme at the Kola nuclear power plant, and thereafter initiated its involvement in the projects connected to handling of radioactive waste in North-western Russia. The total support to Russia during the period 1996-2007 amounted to SEK 270 million.

A cooperation program to Ukraine has also been established. So far the support to Ukraine amounts to about SEK 20 million.

There is extensive international co-operation concerning nuclear safety in Central and Eastern Europe. SIP/ICP and SIUS have participated in relevant activities within EU, IAEA and EBRD[13]. Within the bilateral programmes the efforts have been co-ordinated with other countries' programmes and with the international activities in order to obtain higher efficiency and a concentration of resources.

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[12] As a consequence of the merger of SKI and SSI, as regards international support from regulatory authorities, the responsibilities have been transferred to the Swedish Radiation Safety Authority.

[13] European Bank of Construction and Development

A.8 Highlights and issues in the discussion about Sweden at the second review meeting

During the period before the second review meeting, Sweden received in total 114 questions on the report from 17 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 JC 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. 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 especially noted that Sweden demonstrated good practices with regards to:

- responsibilities for 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
- a long term strategy is in place for disposal of spent fuel and nuclear waste
- public consultation in the decision making process,
- funding mechanism is available for costs for orphan sources and other legacy waste

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

- Continued implementation of the long term strategy to complement the existing management system for spent nuclear fuel and nuclear waste
  Development in this regard is found in section A
- Implementation of improvements to the system of management of non-nuclear waste
  Development in this regard is found in section J
- Implementation of the new financing system
  Development in this regard is found in section E
- Development of acceptance criteria for long lived waste.
  Development in this regard is found in section F
- Development of clearance criteria to support decommissioning activities
  Development in this regard is found in section F

A.9 Summary of developments since the last national report

- The Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Authority (SSI) was merged into a joint organisation, the Swedish Radiation Safety Authority, July 1, 2008 (see section A.5.2).
- The basic nuclear legislation, the Act (1984:3) on Nuclear Activities, has been amended 2006 with regard to use of contractors for nuclear activities. The new provisions limit the number of subcontractors that can be used for one particular activity (see section E). A minor amendment has also been made concerning the responsibilities of the licensee (see section F.1).
- New regulations on physical protection (SKIFS 2005:1) have been issued (see section E).
- New regulations on exemption from the requirement on approval of contractors (SKIFS 2006:1) have been issued (see section E).
- Older regulations on mechanical equipment in nuclear facilities have been amended (SKIFS 2005:2) (see section E).
- New regulations on emergency preparedness have been issued (SSI FS 2005:2) (see section E).
- A new Ordinance (SFS 2005:209) on Producer's Responsibility for Electrical and Electronic Equipment has been promulgated (see section J).
- A new Ordinance (SFS 2007:193) on Producer's Responsibility for Certain Radioactive Products and Orphan Sources has been promulgated (see section J).
- New regulations on the control of high activity sealed sources have been issued (SSI FS 2006:2) (see section J).
- The Act (1992:1537) and Ordinance (1981:671) on the Financing of Future Expenses on Spent Nuclear Fuel etc. is replaced since January 1 2008 by the Act (2006:647) and Ordinance (2007:161) on Financing of Management of Residual Products from Nuclear Activities (see section E).
- A special funding arrangement has been established to cover the costs for the management and final disposal of non-nuclear legacy waste and orphan sources (see section J).
- The Swedish Agency for Public Management was commissioned in May 2007 by the Government to evaluate the financial support to non-profit organisations. The final report was submitted to the Government in April 2008 and is currently under consideration (see section E).
- SKB has taken over operation of the Central Interim Storage for Spent Nuclear Fuel, Clab (see sections D.1.2.3 and F.1.2).
- The extended part of the central interim storage (Clab) was approved for operation in December 2007 (see sections D.1.5 and G.2).
- The central active laboratory (ACL) in Studsvik was released for unrestricted use in the beginning of 2006. The demolition work was carried out during 2006 (see section D.1.5).
- The two units at the Barsebäck site went into service operation December 1, 2006 (see section D.1.5).
- Spent fuel assemblies that has been used in the research reactors R2 and R2-0 at the Studsvik site, has been re-exported to the United States (see section D.1.2).
- The major part of the spent fuel assemblies that has been used in the research reactor R1 has been exported to the United Kingdom for reprocessing (see section D.1.2 and G.2.).
- The melting facility (SMA) at the Studsvik site has been licensed for increased volumes of scrap metal (see section D.1.4).
- The regulatory authorities have jointly reviewed a preliminary safety assessment for a repository for spent fuel (SR-Can) as part of the ongoing consultations between SKB and the Swedish authorities (see section G.5).
- SKB submitted in June 2007 the first cost calculations under the new Act (2006:647) on Financing of Management of Residual Products. The Government decided in December 2007 on the size of fees and guarantees for the nuclear power plant owners organisation (see section H.1).
- SKB submitted in September 2007 the eighth RD&D-program 2007. The regulatory authorities have evaluated the program and submitted a statement to the Government (see section H.1).

Section B - Policies and Practices

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 second Swedish report issued in compliance with Article 32.

B.1.1 Spent fuel management policy

The Swedish policy is that spent nuclear fuel should be managed and disposed of in a geological formation in Sweden.

B.1.2 Spent fuel management practices

After removal from the reactor core the spent fuel elements are stored at the NPP sites for roughly one year before being transported to the central interim storage facility for spent nuclear fuel (Clab). The capacity of the interim storage for spent nuclear fuel (Clab) has recently been increased and the storage capacity is sufficient to provide for storage of all spent fuel to be produced in Swedish NPP's over an average of 40 years of operation.

According to current plans, fuel elements after a storage period of about 30-40 years will be transported to the final repository for spent nuclear fuel. Prior to this they will be placed in a cast iron insert in a copper canister. In the final repository 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 repository is ongoing and described in the introduction in section A. According to SKB's plans, the repository for spent nuclear fuel is expected to commence operation in 2020.

B.1.3 Radioactive waste management policy

The Swedish policy is that radioactive waste that has arisen in Sweden should be managed and disposed of in Sweden.

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 standardised system with predefined waste type descriptions (WTD) and disposed of in the repository for operational waste (SFR 1), in rock caverns in crystalline bedrock. WTD's are subject to approval by the regulatory authority. The repository consists of five different caverns, and wastes are directed to different parts of the repository depending on, e.g. the activity content and chemical characteristics.

Long-lived LILW will be disposed of in a repository in rock caverns in crystalline bedrock. Until the repository has been constructed the long-lived waste will be stored either at the NPP, at Studsvik sites or in storage pools in the interim storage for spent nuclear fuel (Clab).

B.1.5 Criteria to define and categorize radioactive waste

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

- spent nuclear fuel that has been placed in a repository,
- 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.

Section C - Scope of Application

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.3.2.

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.3.3.

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.

Section D - Inventories and Lists

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.

Summary of developments since the last national report

- Spent fuel assemblies that has been used in the research reactors R2 and R2-0 at the Studsvik site, has been re-exported to the United States.
- The major part of the spent fuel assemblies that has been used in the research reactor R1 has been exported to the United Kingdom for reprocessing.
- The two units at the Barsebäck site went into service operation December 1, 2006, The extended part of the central interim storage (Clab) was approved for operation in December 2007.
- The central active laboratory (ACL) in Studsvik was released for unrestricted use in the beginning of 2006. The demolition work was carried out during 2006.
- The melting facility (SMA) at the Studsvik site has been licensed for increased volumes of scrap metal.

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 R1and 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 repository.

Spent nuclear fuel from the closed research reactors R2 and R2-0 in Studsvik has been temporarily stored on site. All spent fuel elements have now 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 aluminium 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 are to be reprocessed and manufactured to MOX-fuel. The MOX-fuel shall be imported back to Sweden to be used in Swedish NPPs. The corroded parts of the R1-fuel are still temporarily stored at the Studsvik site.

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 2007-12-31 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 2007-12-31 (no of assemblies)	(tonnes*)
Oskarshamn 1	908	366	55
Oskarshamn 2	1022	271	44
Oskarshamn 3	1040	328	58
Forsmark 1	602	482	77
Forsmark 2	491	398	64
Forsmark 3	391	303	50
Ringhals 1	1426	562	92
Ringhals 2	432	198	86
Ringhals 3	381	147	64
Ringhals 4	364	152	66

*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, part of the spent fuel from the research reactors R2 and R2-0 is temporarily stored on site before being exported to the United States. The remaining corroded parts of the R1 fuel are temporarily stored on site until decision has been made concerning managing and final disposal.

Spent nuclear fuel in storage 2007-12-31		
Origin	No of assemblies	Kg*
R1**	27***	82,3****

*Uranium weight

**The corroded parts of the R1 fuel

***Steel cans

****Consists mostly of uranium dioxide (UO_2)

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

The fuel pool at the R2 and R2-0 reactors constitutes an integrated part of the reactor facility, and is for the purpose of the Joint Convention not considered to be a separate spent fuel management facility.

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 being to permit the heat generation to 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.

Clab is situated at the OKG site, on the Simpevarp peninsula, and was taken into operation in 1985. 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. Clab has recently been expanded and the storage capacity has been increased from 5 000 to 8 000 tons. The storage part consists of two caverns approximately 120 metres long, each containing five storage pools. The facility is schematically illustrated in figure D1.

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 90 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 licence holder for Clab, SKB, took over the operation of the Clab facility, which earlier was handled by OKG (see also section F.1.2).

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.

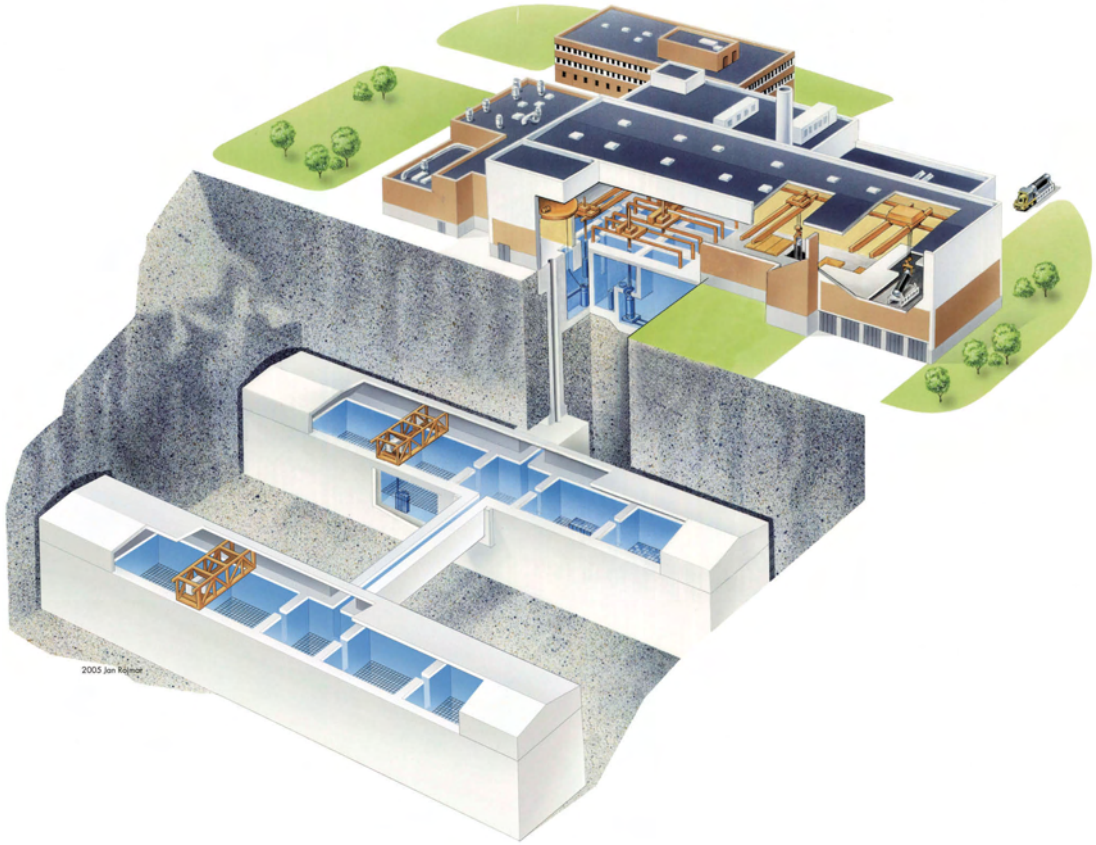

Figure D1: The central interim storage for spent nuclear fuel, Clab. The pools in the lower left-hand corner, Clab 2, were taken in operation 2008-01-01.

Principal data for Clab (including Clab 2)	
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 90
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

Specification	Spent nuclear fuel stored 2007-12-31 (no of assemblies)	(tonnes)
BWR fuel	20 953	3562
PWR fuel	2 482	1068
Fuel from Ågesta district heating nuclear power reactor	222	20
Fuel from Studsvik	19	3
German MOX-fuel (exchanged for Swedish fuel reprocessed in France)	217	23
Total	**23 893**	**4 676**

Table D3: Inventory of spent fuel stored in Clab 2007-12-31.

D.1.3 Management of radioactive waste

Waste management at the NPP sites is fully integrated into the operations at each site. Fulfilment of the requirements in SKI'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.

Short-lived low and intermediate 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 D2). Waste packages are stored temporarily in a buffer storage on site before being transported to the repository for operational waste, SFR.

Figure D2: 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 bitumen and packed in steel drums. Dewatered and packed in concrete tanks.	Solidified in concrete and packed in concrete moulds. Dewatered and packed in concrete tanks.	Solidified in bitumen and packed in steel drums and steel moulds.
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.	Casted in concrete and packed in steel moulds. Packed in standard ISO containers.
Sludges	Solified in concrete, packed in concrete moulds.			

Table D4: 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 the 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 stabilised in concrete for disposal or, if the waste comes from overseas, returned to the origin for further management. The current licence permits the treatment of 600 tons of combustible waste annually. The exhaust gas and ventilation systems are monitored for any radioactive substances.

The melting facility, SMA

The melting facility in Studsvik is used for volume reduction of contaminated metal scrap. After melting and radiological measurement, the material may be exempted from regulatory control or returned to the source for further management. The current licence permits the treatment of 5 000 tons of metal annually. The exhaust gas and ventilation systems are monitored for any radioactive substances.

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 stabilisation with concrete. Treatment of liquid waste comprises sedimentation and solidification by means of stabilisation with concrete. The ventilation and drainage systems are monitored for any radioactive substances.

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 is dimensioned to receive waste until about the year 2020. 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 maximum capacity corresponding to 14 400 drums of 200 litres, the unshielded part can hold 4 600 drums. 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, and
- decommissioning waste from old nuclear facilities.

Number of packages	Volume (m^3)*	Mass (tonnes)*	Activity (Bq)
2 650	1 708	2 978	$1{,}16*10^{16}$

*Including packaging

Table D5: Inventory of disposed radioactive waste in AM 2007-12-31.

Storage 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 storage facility (FA)
This facility, which contains two 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 above ground level in the main building. There are three pools; one for loading/unloading of transport casks and two for the storage of spent fuel assemblies.

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 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 approximately 5 500 drums with historical waste consisting of ash and scrap metal embedded in concrete. During the 1990's the waste was reconditioned. The waste will be disposed of in the repository for other long-lived waste. No more waste will be stored in the building.

D.1.4.3 Repository for radioactive operational waste (SFR)

General information

SFR is designed for the disposal of low and intermediate level radioactive waste from the Swedish nuclear power plants and Clab, and for similar waste from other industry, research and medical usage which is treated in Studsvik before being transported to SFR. SFR is situated in the northern part of Uppland, close to the Forsmark nuclear power plant. The licence holder for SFR, SKB, has made an agreement with the operating organisation for the FKA NPPs, for the operation of SFR. Thus, the operating organisation of SFR is fully integrated with the management system and organisation of FKA. Approximately 12 people work at the facility.

SFR is designed for the disposal of 90 000 m^3 of waste. In the safety assessment the total radioactivity of this waste is assumed to be 1E16 Bq. The capacity of the existing parts of the facility (SFR-1) is approximately 63 000 m^3, and 31 768 m^3 of waste has already been disposed of by 2007-12-31.

The repository 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-1 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 repository is accessed through two tunnels.

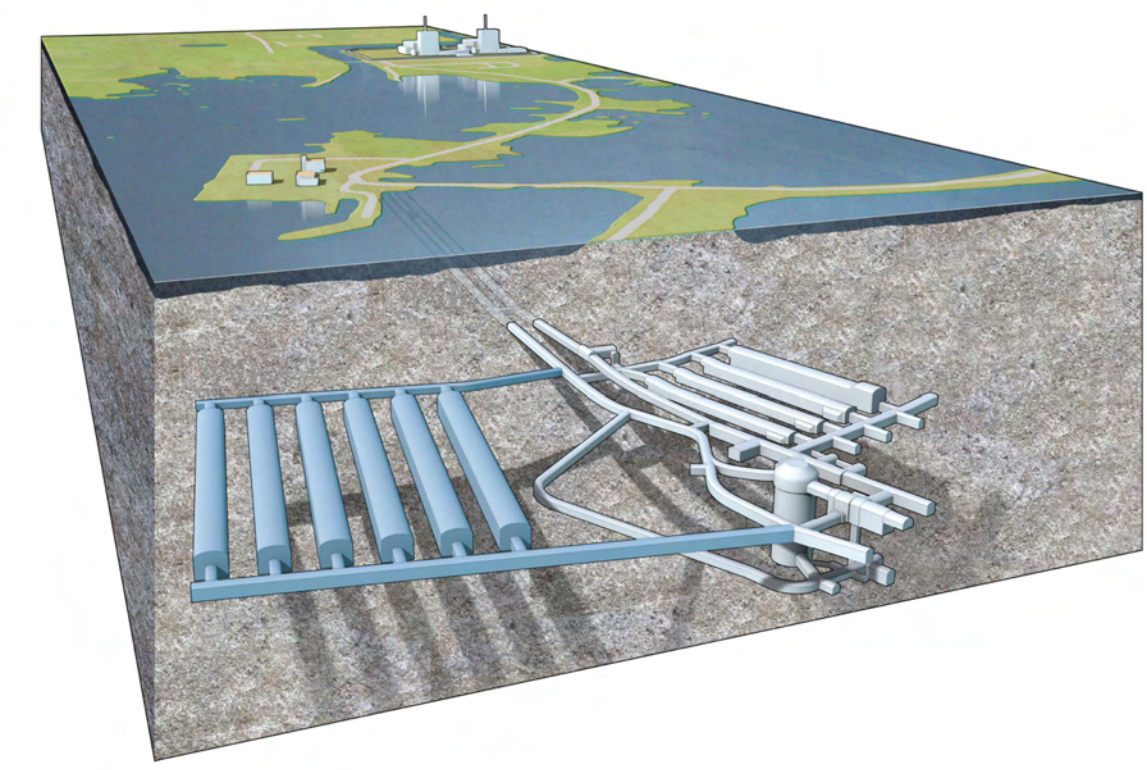

Figure D3: The repository for radioactive operational waste, SFR. The blue coloured part represents a planned extension for decommissioning waste.

The Silo

The main part of the radioactivity in the waste designated for SFR-1 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 stabilised 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-1. 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 repository is closed.

The rock vaults for concrete tanks (BTF)

In SFR-1 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 rector 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 m3 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 stabilised 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, aluminium); 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 minimise water dripping onto the waste. This inner roof will be dismantled before the repository 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.

Principal data on SFR-1

Owner and license holder:	Swedish Nuclear Fuel and Waste Management Co (SKB)
Operation and maintenance:	FKA AB
Start of construction:	1983
Start of operation:	1988
Number of staff:	Approximately 12
Storage capacity (total):	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 m^3/year

Inventories of disposed radioactive waste in SFR

Waste disposed of in SFR 2007-12-31 Storage section	Number of packages	Volume (m^3)	Activity (Bq)
Silo	4 196	4 779	5,95E14
BMA	9 920	8 950	3,13E14
1 BTF	4 841	2 309	2,54E12
2 BTF including	641	6 410	1,70E13
steam separators	18		2,4E12
BLA	406	9 320	6,03E11
SFR total	**20 004**	**31 768**	**9,29E14**

Table D6: Inventories of disposed radioactive waste in SFR 2007-12-31.

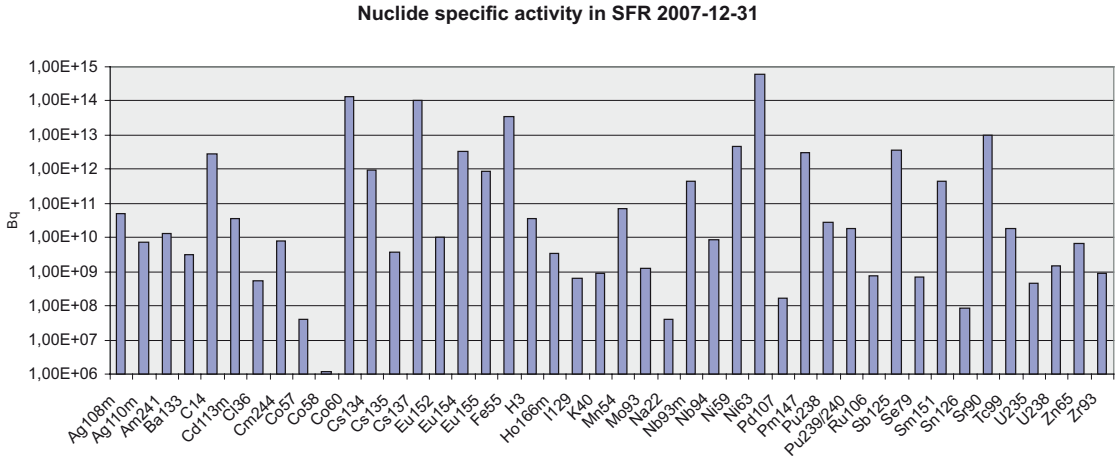

Figure D4: Nuclide specific inventory for isotopes exceeding 1E6 Bq in SFR-1.

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 repository. 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.

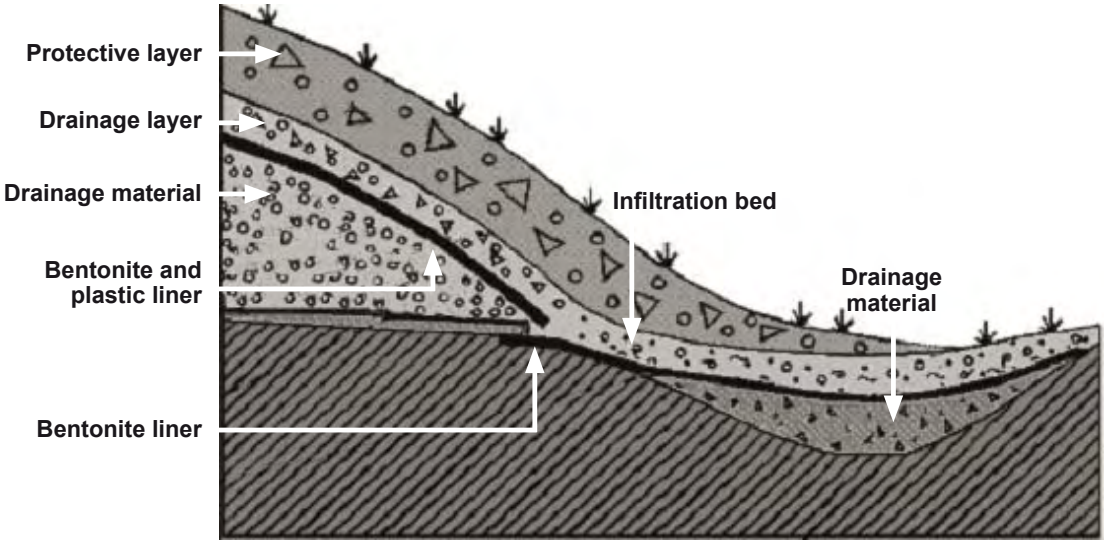

Figure D5 A: Principle section of shallow land burial at OKG.

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 D5 B: The shallow land burial at OKG.

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

The Regulations on the Protection of Human Health and the Environment in connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste (SSI FS 1998:1) 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 2007-12-31		
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	2 463	3 929	22/0.0004
Oskarshamn	2 025	10 000	200/0.2	3 768	7 346	38/0.0028*
Ringhals	2 030	10 000	1100/0.1	2 410	3 471	12/0.032
Studsvik	2 010	1 540	100/0.1	1 151	1 140	46/0.055*

*Valid 2004-12-31

Table D7: Inventories of disposed waste in shallow land burials. In addition to the above mentioned limits the following applies to the shallow land burials. In the license conditions for Oskarshamn the maximum activity allowed is 200 GBq out of which 20 GBq may be Cs-137. 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 SSI. 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 final repository.

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 is now stored in the interim storage, AM. 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. A detailed 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 2008. The decommissioning work has commenced to a certain degree. 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 2017.

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 facility is now in the process of being decommissioned. The remaining parts consist of two concrete silos lined with ceramic tiles.

The research reactors R2 och R2-0 in Studsvik were finally shut down 15 June 2005. SKI increased the monitoring activities at the site as soon as Studsvik announced the decision to finally shut the research reactors down, and is closely following 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.

Section E - Legislative and Regulatory System

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 fulfil 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

- The basic nuclear legislation, the Act (1984:3) on Nuclear Activities, was amended 2006 with regard to use of contractors for nuclear activities. The new provisions limit the number of subcontractors that can be used for one particular activity.
- New regulations on physical protection (SKIFS 2005:1) has been issued
- New regulations on exemption from the requirement on approval of contractors (SKIFS 2006:1) have been issued.
- Older regulations on mechanical equipment in nuclear facilities have been amended (SKIFS 2005:2).
- New regulations on emergency preparedness have been issued (SSI FS 2005:2).
- 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 Financing of Management of Residual Products from Nuclear Activities.
- The Swedish Agency for Public Management that was commissioned to evaluate the financial support to non-profit organisations submitted the final report to the Government in April 2008.

This section is divided into two parts. The first part (E.2.1) presents some basic information concerning definitions within the Swedish legislative system, and presents an overview of the relevant acts. The second part (E.2.2) 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.

Fundamental principles

The rationales for the management system for spent fuel and radioactive waste are based on basic principles that have been derived from extensive discussions in the Swedish parliament. 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 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.

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 Financing of 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. The fourth principle is embodied 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 repository.

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

The Acts are supplemented by a number of ordinances and other secondary legislation, which contain more detailed provisions for particular aspects of the legal framework.

E.2.1.1 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 every 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 radioactive 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, on condition 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.2.1.2). 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 repository.
- A radioactive substance formed in a nuclear plant and which has not been produced or removed from the plant to be used in 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 such a plant.
- Radioactive parts of a nuclear plant that is being decommissioned.

Basic requirements on safety
Nuclear activities shall be conducted such that they 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.

Licensing
In principle, all activities with nuclear material or nuclear waste are deemed to 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. This is a very general obligation and it has to be complemented with licensing conditions. 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
In all licensing cases according to the Act on Nuclear Activities an EIA (Environmental Impact Assessment) shall be made. The Environmental Code regulates the way in which the EIA shall be performed as well as its contents. The general rules of consideration in the Environmental Code shall also be complied with in licensing cases according to the Act on Nuclear Activities (see section E.2.1.3).

Safe management and disposal of nuclear waste
The holder of a licence for conducting 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 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. 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 the regulatory authority forwards the R&D-programme to the Government to make a decision, whether to approve the programme or not. In connection with the decision, the Government may issue conditions about the content of the future R&D-programme.

Supervision
The Government assigns a regulatory body to supervise the compliance with the Act on Nuclear Activities and of conditions or regulations imposed pursuant to the Act. A licence-holder shall if the regulatory body requires it:

- submit all information and documentation necessary to execute the supervision; and
- provide access to a nuclear installation, or site for nuclear activities, investigations and tests to the extent needed for the supervision.

The regulatory body 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.2.2.3

Documentation and reporting
See section E.2.2.3

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 only 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 rules about 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.

Civil liability for nuclear damage is regulated in the Atomic Liability Act (1968:45) which came into force in 1968. Sweden is one of the parties to the Paris Convention and to the Brussels Supplementary Convention on this subject. The Swedish Act reflects these agreements.

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 these municipalities.

The licence-holder for a major nuclear plant is bound to allow 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 specify that the regulatory authority assigned by the Government 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.

Regulations on nuclear safety
Regulations Concerning Safety in Certain Nuclear Facilities (SKIFS 2004:1)
The general regulations is written for 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 SKI 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 (SKIFS 2002:1)
These regulations, in force since 2002, contain specific requirements on design, construction, safety analysis and safety report for final repositories, in view of the period after closure of the facility. For the period before closure, the general safety regulations (SKIFS 2004:1) apply.

These 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 Physical Protection of Nuclear Facilities (SKIFS 2005:1)
These non-classified regulations, in force from 1 January 2007, contain requirements on organisation of the 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. These regulations replace older requirements from 1975.

Regulations on exemption from the requirement on approval of contractors (SKIFS 2006:1)
These regulations, in force from 1 February 2007, are a result of a recent change in the Act on Nuclear Activities regarding the use of contractors (see section 7.1). The basic provision is that a licensee can not without a permit by the Government or the regulatory body contract out an activity that is included

in the licence. Now, a possibility has opened to exempt certain activities from the permit requirement. If the activity is suitable and the licensee controls and follows up on the contractor's work, the permit can be replaced by a notification to the regulatory body. The regulatory authority is authorized by the Government to specify the prerequisites for these exemptions.

The regulations contain a list of activities that can be contracted out without a permit. This list includes building and construction work, decommissioning work, maintenance and inspection work, training, qualified expert tasks that can not 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.

E.2.1.2 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 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.

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. The Act was amended in 2006 to to the Act in 2006

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 the responsible authority may, in licensing cases, prescribe that the implementer makes 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.2.1.3).

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. The regulatory body 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 responsible authority, anyone who conducts activities involving radiation shall submit the information and provide the documents required for its supervision. The authority 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.2.2.3

Documentation and reporting
See section E.2.2.3

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.

Regulations and guidelines on radiation protection
Currently there are 47 regulations in force covering all the areas in which radiation can occur. In general these requirements and regulations are in agreement with recommendations by international organisations such as IAEA, ICRP, EU. There are 15 regulations of particular interest for nuclear and radioactive waste management.

SSI FS 2005:5 Guidelines on the application of the regulations (SSI FS 1998:1) concerning protection of human health and the environment in connection with the final management of spent nuclear fuel and nuclear waste

The guidlines clarifies the regulations concerning geological disposal of nuclear waste and spent nuclear fuel, including the following main areas:

- BAT and optimization,
- The risk criterion and most exposed group,
- Time periods for the risk analysis and,
- Reporting of the risk analysis and compliance demonstration for different time periods.

SSI FS 2005:01 Regulations and General Advice on the handling of Ashes Contaminated by Caesium-137
These regulations are applicable during the handling of ashes generated in 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 final waste deposit site if the ashes are deposited.

SSI FS 2002:4 Regulations on the Planning Before and During Decommissioning of Nuclear Facilities
These regulations contain provisions concerning the planning of decommissioning of nuclear facilities in matters of importance from a radiation protection point of view. Requirements are put on decommissioning planning and other administrative measures such as documentation before and during decommissioning and reporting to the regulatory authority at different stages of a facility's life cycle.

SSI FS 2001:1 Regulations on the Handling of Radioactive Waste and Nuclear Waste at Nuclear Facilities
These regulations contain provisions concerning the planning and quality assurance of radioactive waste management at nuclear facilities, as well as documentation and registration of radioactive waste and reporting to the regulatory authority.

SSI FS 2000:12 Regulations on the Protection of Human Health and the Environment from Discharges of Radioactive Substances from certain Nuclear Facilities
These are applicable to all releases of radioactive substances from nuclear facilities that are directly related to the normal operation at each facility. The limitation of releases of radioactive substances from nuclear facilities shall be based on the optimization of radiation protection and shall be achieved by using the best available technique. 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). The regulations are under revision.

SSI FS 2000:11 Regulations on Radiation Protection Manager at Nuclear Plants
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. The regulations are under revision.

SSI FS 2000:10 Regulations on Radiation Protection of Workers Exposed to Ionising Radiation at Nuclear Plants
These regulations apply to workers at nuclear plants. The work shall be performed in such a way that human exposures are limited as far as reasonably achievable, social and economical 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. The regulations are under revision.

SSI FS 1998:5 Regulations on Monitoring and Reporting of Individual Radiation Doses
These regulations apply to measurements of individual radiation doses to workers of category A working with ionising radiation and reporting of doses received to the National Dose Database.

SSI FS 1998:4 Regulations on Dose Limits at Work with Ionising Radiation
These regulations apply to the limitation of radiation doses to workers and the general public resulting from applications using ionising radiation. The regulations also apply to the protection of pregnant women who otherwise might be exposed to ionising radiation by their work.

SSI FS 1998:3 Regulations on Categorisation of Workplaces and Workers at Work with Ionising Radiation
These regulations apply to applications using ionising radiation where humans may receive radiation doses.

SSI FS 1998:1 Regulations on the Protection of Human Health and the Environment in connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste
These regulations apply to the final management of spent nuclear fuel and nuclear waste. The regulations do not apply for low-level nuclear waste landfills in accordance with 19 § of the Ordinance (1984:14) on Nuclear Activities. According to the regulations human health and the environment shall be protected from detrimental effects of ionising radiation, during the time when the various stages of the final management of spent nuclear fuel or nuclear waste are being implemented as well as in the future. The final management may not cause impacts on human health and the environment outside Sweden's borders that are more severe than those accepted inside Sweden.

SSI FS 1997:1 Regulations on Filing at Nuclear Plants
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.

SSI FS 1996:3 Regulations on Outside Workers at Work with Ionising Radiation
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.

SSI FS 1996:2 Regulations on Clearance of Goods and Oil from Nuclear Facilities
These regulations set up the levels for clearance of contaminated goods and oil from nuclear facilities. Material may be cleared for unrestricted use or for disposal as conventional non-radioactive waste. The regulations are under revision.

SSI FS 1995:4 Regulations on the Control of Shipment into or out of Sweden of Radioactive Waste
These regulations deal with the supervision and control of shipments of radioactive waste between European Community member states and into and out of the Community. Due to the new Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel the regulations will be revised and enter into force before 25 December 2008.

SSI FS 1983:7 Regulations on Radioactive Waste Not Associated with Nuclear Energy
These regulations apply to the handling of solid and liquid wastes from medical care, laboratories and science. The regulations are under revision.

E.2.1.3 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 and applies to all activities, which are important for its objective. The Code is applicable to all kinds of environmentally hazardous activities including nuclear activities and activities involving radiation. The Code shall be applied in parallel with the Act on Nuclear Activities and the Radiation Protection Act.

The Environmental 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 responsible authority may issue regulations on the specific knowledge the implementer needs to possess.
- 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. Such precautions shall be taken as soon as there is cause to assume that an activity may cause damage or be detrimental to human health or the environment.
- 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 with 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 or notification is required for environmentally hazardous activities (9 chapter). 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.

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 County Board conducts supervision of the Governments permissibility decision and the Environmental Court's judgement.

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.2.1.4 The Act (2006:647) on Financing of Management of Residual Products from Nuclear Activities

The Swedish Parliament has decided on a new legislation for the financing of the license-holders general obligation according to the Nuclear Activities Act. 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 Financing of Management of Residual Products from Nuclear Activities.

The general obligations stated in the Nuclear Activities Act 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 new legislation is in essential parts the same for all licensees and is binding until the obligations stated in the Nuclear Activities Act have been fulfilled or exemption from them has been granted.

Definitions
The definitions of nuclear facility, nuclear reactor, nuclear material and nuclear waste are the same as the definitions according to the nuclear activities act. 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 final disposal ,and surveillance and control of a final disposal,
- the licensees, State's and municipalities costs for information to the public concerning handling and final disposal of spent nuclear fuel and nuclear waste,
- the costs for economical support to non-profit organisations for efforts in connection to the siting of facilities for handling and final 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 must 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 the possibility to allow exemption to the obligation to pay a nuclear waste fee on the condition that the licensee provides a guarantee to cover its costs.

In addition to the obligation to pay a nuclear waste fee, the licensees must also provide guarantees for the costs the fee shall cover but which have not yet been paid. 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 nuclear activities act 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 fully ringed-fenced governmentally controlled and administered fund. The funds are managed through a suitable combination of deposits in accounts at the National Debt Office or in nominal and real interest rate government bonds on the regular domestic market.

The financial risk of the State
If it is needed 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 funded means shall be used for the reimbursements of costs which the nuclear waste fee is meant to cover. If the Nuclear Waste Fund is proven inadequate the guarantees shall be used to cover the costs.

Supervision
A licensee is obligated to submit cost estimates and other information which might be required to fulfil 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.

The Ordinance (2007:161) on Financing of Management of Residual Products from Nuclear Activities[14)]

Cost estimates
The legislation requires the licensees to submit, every three years, estimates of all future costs for management and final 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 build up of adequate financial resources on the expected remaining period of operation.

Guarantees
In addition to pay a fee on electric energy production 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 repository. 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 was estimated.

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.

Risk assessment and risk fee
The Swedish National Dept Office shall every three years establish the State's credit risk for the provided guarantees. A licensee of a nuclear power reactor must 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 Dept Office.

Reimbursements to licensees
The licensees are entitled to reimbursement, 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.

Reimbursements to municipalities
Municipalities that might host a spent nuclear fuel or nuclear waste facility, including a repository, are reimbursed for their information to the public. Currently the municipalities of Östhammar and Oskarshamn are receiving reimbursements from the Nuclear Waste Fund.

[14)] The Ordinance has, as a consequence of the establishment of the Swedish Radiation Safety Authority, been replaced by the Ordinance (2008:715) on Financing of Management of Residual Products from Nuclear Activities.

Reimbursements to non-profit-making organisations
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, for the period of 1 January 2005-31 December 2008. According to the Government's bill (2003/04:116) the issue of final 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. To get financing the non-profitmaking organisations must have at least 2 000 members, a democratically elected board and a charter of the association, which is decided by the associations' assembly.

The Swedish Agency for Public Management was commissioned in May 2007 by the Government to evaluate the financial support to non-profit organisations. The final report was submitted to the Government in April 2008 and is currently under consideration. The Swedish Agency for Public Management proposes a prolongation of the support for a given time after the last public consultation prescribed by the Environmental Code. The reason for the consideration is to give the non-profit organisations as good conditions as possible to prepare the statement on the Environmental Impact Assessment which will be submitted to them for consideration by the Environmental Court. It is proposed that the financial support may go on for 12 months after the organisations have had the opportunity to submit their statement to the Environmental Court.

Supervision of the overall system
The regulatory assigned by the Government reviews the cost estimates according to the Act (2006:647) on Financing of Management of Residual Products from Nuclear Activities. The Government sets the fees and guarantees for the licensees of nuclear power reactors. The regulatory 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 regulatory authority decides on the reimbursement of funds to the nuclear licensees, the municipalities and the non-profit organisations. However, certain minor amounts are decided by the Government. Furthermore, the regulatory authority is responsible to control that the nuclear utilities has made the payments to the Fund and also to audit the disbursements.

E.2.1.5 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. 1334/2000 of 22 June 2000 setting up a Community regime for the control of exports of dual-use items and technology. To obtain permission for export requires an application to be made to the Swedish National Inspectorate of Strategic Products, that makes the decision as to whether to issue the necessary permission or not.

The Swedish Radiation Safety Authority[15] has had jurisdiction to decide certain cases on the export of dual-use items that are connected to nuclear activities, such as nuclear fuel.

The Act specifies, through reference to the Radiation Protection Act, that a licence to export spent nuclear fuel from Sweden cannot be given if the destination is:
south of latitude 60 degrees south;
- a State party to the Fourth ACP-EEC Convention which is not a member of the European Union;
- a State that has forbidden the import of spent nuclear fuel; or
- 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 safely.

Recently issued Regulations on Nuclear Safeguard and Export Control (SKIFS 2008:1) establishes more stringent national requirements in the field of nuclear non-proliferation. The regulations are a compliment to the Commission Regulation (Euratom) No 302/2005 of 8 February 2005 on the application of Euratom safeguards. It also establishes the procedure to fulfil the requirement in Council Regulation (EC) No 1334/2000 of 22 June 2000 setting up a Community regime for the control of exports of dual-use items and technology.

[15] The Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Authority (SSI) was merged into a joint organisation, the Swedish Radiation Safety Authority, July 1, 2008.

E.2.1.6 Other Relevant Acts

The Civil Protection Act
In 2003, a new act (2003:778) came into force on protection against accidents with serious potential consequences for human health and the environment. Also a new Ordinance came into force under the same title. The Act as well as the Ordinance replaces the Rescue Services Act (1986:1102) and it's Ordinance that was referred to in Sweden's first report to the Joint Convention.

The Civil Protection Act (2003:778) 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 decide on necessary measures for the nuclear installations.

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

The Act on Transportation of Hazardous goods
The Act concerning the Transportation of Hazardous goods (2006:263) and the Ordinance (2006:311) on the Transportation of Hazardous goods.

E.2.2 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.2.2.1 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
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 nuclear 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 only permit an activity if a municipal council has already approved it (municipal veto). But without prejudice to a 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, 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

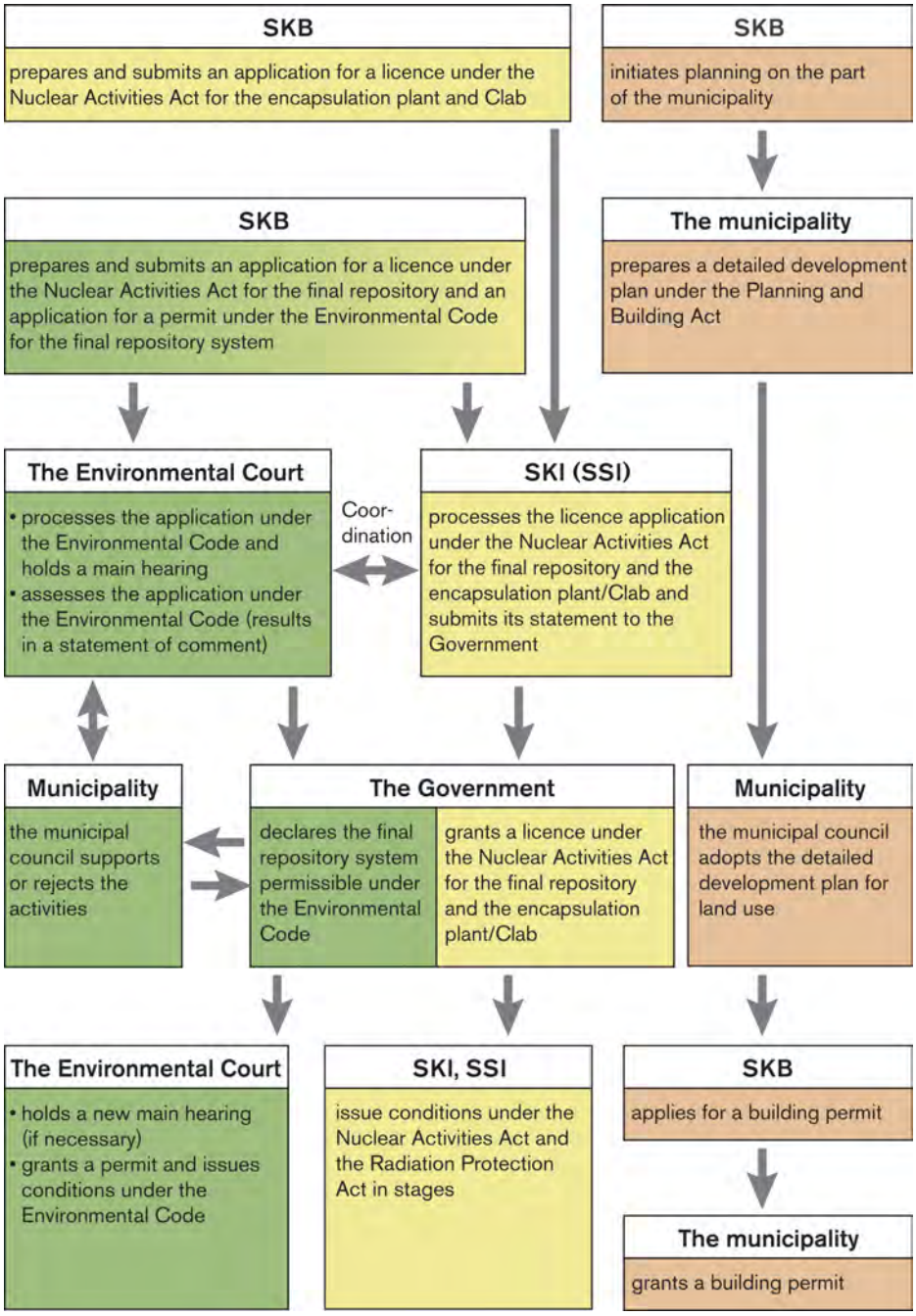

Figure E1: Licensing procedure for nuclear facilities as presented in RD&D-program 2007.

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.

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. The conditions could be issued in connection with such approvals or during the period of validity of the permits.

In connection with the permissibility decision the Government could issue conditions in order to safeguard public interests, such as the labour market, trade and industry and regional politics. The implementer could e.g. be requested to pay for improvements to the roads in the area where the facility is sited.

It should be mentioned that during the last ten years there has been a development among the responsible authorities to issue general regulations instead of licensing conditions. The difference between licence conditions and general regulations is that conditions are linked to individual licences while general regulations apply to all licence-holders (provided that their activities are within the scope of the regulations). General regulations have the advantage of providing the same standards for all licence-holders and thus help in establishing an objective and unbiased regulatory framework. Furthermore, regulations are often an efficient way to handle matters that could otherwise generate a large number of individual applications.

Shallow land burials
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 repository 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
The responsible authorities may issue all conditions or regulations necessary with regard to aspects of safety, radiation protection and environmental protection.

Non-nuclear radioactive waste
For non-nuclear radioactive waste 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.2.2.2 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.2.2.3 Institutional control, regulatory inspection and documentation and reporting

Institutional control

According to regulations on radiation protection[16] 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[17], 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. The County Administrative Board fulfils supervision of the compliance with the Environmental Code and conditions or regulations imposed by the Code.

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.2.1.1 and E.2.1.2).

Previous SKI practice

Over the last few years, SKI developed its inspection practice as a result of the new general safety regulations (SKIFS 2004:1). These regulations made it possible to adopt a more structured approach to inspection and safety assessment.

Topical inspection

Topical inspections are carried out with a team of experts, to assess the licensee's compliance with relevant regulations. These inspections are documented in extensive reports covering the purpose and objectives of the inspection, observations, compliance and deviations from requirements, as well as an assessment of the magnitude and safety significance of the deviations, and a proposal for further regulatory action. Careful planning is needed for these inspections, documented in an inspection plan.

Covering current plant issues

The purpose of this practice is to be generally informed about activities at the plants, to collect information about plans, the status of ongoing projects, etc. Another purpose is to have a practical possibility of detecting early signs of deteriorating performance. The information is used by SKI for preparation and planning of regulatory activities. Preparation and documentation is simpler than for topical inspections.

SKI Forum

As mentioned in the first national report SKI has developed a practice called the SKI Forum. This is an annual integrated safety evaluation of each major facility supervised by SKI. The evaluation covers the status in 15 areas, such as plant safety, waste management, physical protection and safeguards. Based on all the inspections and safety assessments concerning the facility, as well as information from ”covering of current plant issues”, a general conclusion is made regarding the safety of the facility in relation to relevant requirements. The findings and conclusions are documented in report, which is an important tool for prioritising further regulatory activities. SKI Forum has now become an established practice at SKI and found to be most valuable for maintaining an updated picture within SKI of the safety issues of the plants, and for prioritising and planning of other regulatory activities. It has also shown to be a strong information basis for top management discussions between SKI and the licensees.

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16) Regulations on the Protection of Human Health and the Environment from Discharges of Radioactive Substances from certain Nuclear Facilities (SSI FS 2000:12)

17) Ordinance (2008:715) on Financing of Management of Residual Products from Nuclear Activities.

Special supervision
Besides the mentioned practices, SKI also has a special instrument called ”special supervision”. The use of this supervision is decided by the Director General and is applied in cases where SKI is not satisfied with the safety performance of a nuclear facility. It can also be applied for other special safety reasons, e.g. during testing operation after large plant modifications. The special supervision regime means that inspections are made on a tighter schedule and special progress reporting is required of the licensee.

Previous SSI practices
The inspection policy, decided by the Director General, defined the following types of inspections to be performed.

System inspections
During system inspections the licence holder's organisation, administrative routines, co-ordination within the organisation, division of responsibilities and competence are in focus. The aim of system inspections is to obtain good knowledge of the quality system within the organisation of the licence holder.

Detailed inspections
In a detailed inspection one specific issue is in focus. A detailed inspection could e.g. be triggered by an unexpected radiological event.

Theme inspections
A theme inspection is coordinated and performed towards several licence holders, on a specific theme (e.g. air monitoring programme at the nuclear facilities).

Joint SKI-SSI inspections
Because of the strong links between nuclear safety and radiation protection SKI and SSI have co-operated in the supervision of the nuclear facilities. Usually the authorities co-operated in major safety assessments, e.g. periodic safety reviews, PSR, and in reviews of licensee's applications for different plant or technical specification modifications. Joint inspections were carried out occasionally.

Another area of concern is the long-term performance of repositories. Only waste packages approved by SKI and SSI has been allowed to be transported to a repository, after a joint expert group to review the fulfilment of requirements related to the disposal of waste packages, especially with regard to long-term performance. One important tool in the review activities has been the verification of compliance with procedures by means of inspections at the sites.

Documentation and reporting
According to the annual letters of appropriation, government decisions 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 repository 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.2.2.4 Enforcement of regulations and terms of licences

The authorities have extensive legal regulatory and enforcement power. As described in section E.2.2.2 concerning prohibition, a licence may be revoked for activities that do not fulfil the obligations set out in the legislation. If there is an ongoing 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, under 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.2.2.5 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.2.3 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

The Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Authority (SSI) was merged into a joint organisation, the Swedish Radiation Safety Authority, July 1, 2008. The new authority has been tasked with the responsibility and tasks from SKI and SSI. More information in this regard can be found in section A.5.2. The formal procedure to process the national report did not allow for a proper account of the new organisational setting, as the transition period was not completed before the report had to be compiled. Thus, the report describes the situation as per June 30, 2008.

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 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 specified parts of the legal authority given to the Government by the Parliament through legislation.

The Swedish Radiation Safety Authority is the regulatory body in Sweden authorized to supervise spent fuel management and radioactive waste management according to the Act on Nuclear Activities as well as the Radiation Protection Act. The County Administrative Board exercises supervision in compliance with the Environmental Code. In addition, the Swedish Rescue Services Agency is responsible for evaluating the major emergency preparedness exercises on-site at the nuclear facilities and off-site according to the Civil Protection Act and the Civil Protection Ordinance.

The Swedish Radiation Safety Authority reports to the Ministry of the Environment. In the Swedish public administration system the central administrative authorities are quite independent within the legislation and the statutes given by the Government. An individual minister cannot, according to the Swedish Constitution, interfere in specific administrative cases that are being handled by an administrative authority under the Government.

The ministries are small units, by comparison with ministries in most other countries. They are concerned with:
(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 as a whole is responsible for all governmental decisions. Although in practice a great 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 government work.

The regulatory authority is headed by a Director General appointed by the Government, normally for a period of six years.

Every year the regulatory authority has to submit reports to the Government, e.i. the Ministry of Environment. In addition, all matters, for instance licensing issues to be decided by the Government, are sent to the Ministry. Every year the regulatory authority shall also submit proposals or recommendations

to the Ministry on issues that have been assigned to the authority in the annual letter of appropriation. Often, on the basis of practical experience, the authority proposes amendments to laws and regulations to be decided upon by Parliament and the Government.

The system and means by which the Swedish Government controls the activities of government authorities were completely revised during the 1990s. Previously the activities of authorities were controlled by detailed rules for each type of activity and detailed control of each type of cost, such as salaries, foreign travel, domestic travel, etc. In the present system, the emphasis is on the objectives set by the Government for each authority, in their annual letter of appropriation, after an evaluation of the results and effects of the authority's activities in relation to its expenditure. This evaluation shall be made in the Annual Activity Report of each authority.

There are very high requirements and expectations on the regulatory authority regarding openness and the provision of information services to the Government, the media and the public. Most official documents in Sweden are accessible to the media and to private citizens. All files of any administrative office are open to the public unless classified as "secret", according to the Freedom of the Press Act and the Secrecy Act. Reasons for secrecy could be related to military security, international relations, or the privacy of individuals concerned, should they for instance contain criminal or medical records, etc. Nobody is obliged to justify his wish to see a public document or to reveal his identity to get access to the document.

E.3.1.2 Regulatory authorities

This section provides information on the former regulatory authorities SKI and SSI, responsible for regulatory supervision and review of nuclear safety and radiation protection, respectively, until June 30, 2008. SKI and SSI was merged into a new regulatory body, the Swedish Radiation Safety Authority July 1, 2008. Information on the new regulatory authority can be found in section A.5.2.

The Swedish Nuclear Power Inspectorate (SKI)

The former Swedish Nuclear Power Inspectorate's (SKI) missions and tasks has been defined in the Ordinance (2006:520)[18] with instruction for the Nuclear Power Inspectorate and in the annual letters of appropriation where the Government issues directives for the authorities including the use of appropriations. The Ordinance stated that SKI was the central administrative authority for nuclear safety including physical protection, final disposal of nuclear material and nuclear waste, nuclear non-proliferation and decommissioning of nuclear facilities.

SKI should deal with any civil service matter within its area of responsibility, issue regulations, regulate the nuclear activities and supervise and exercise control over final repositories. SKI shall also handle certain financial issues with regard to nuclear waste and provide technical advice to authorities responsible for protection of the public in cases of a nuclear accident within or outside the country. In addition, the following more detailed tasks are mentioned:

1. follow the development within the nuclear energy area,
2. take the initiative to research that is needed for the nuclear supervision and for promoting national competence,
3. actively contribute to information of the public about national nuclear safety and waste safety work,
4. handle tasks following from Sweden's international obligations within SKI's areas of responsibility,
5. take part in international cooperation aiming at development of nuclear safety, transport safety, spent fuel and nuclear waste safety and decommissioning,
6. assist the Government with investigations, statements and expert knowledge when needed.

The SKI missions have been conducted within four main sectors: reactor- and nuclear materials safety, nuclear non-proliferation, nuclear waste safety and, since 2007, nuclear waste economy. In addition SKI has been involved in international development co-operation within the areas of reactor safety, nuclear waste safety and non-proliferation. The development cooperation is administered through a separate unit, the International Cooperation Programme, reporting directly to the Director General.

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[18] The Ordinance was replaced July 1, 2008, by the Ordinance (2008:452) with Instruction for the Swedish Radiation Safety Authority

With regards to *nuclear waste safety*, the following tasks were specified in the 2007 letter of appropriation:

1. Maintain effective safety requirements
2. Supervise licensee's responsibility for nuclear waste safety
3. Push safety work forward nationally and internationally when motivated by experience, research and technical development
4. Develop and maintain national competence with regard to nuclear waste safety
5. Maintain an active information, reporting and transparency towards the public

With regards to *nuclear waste economy*, the following tasks were specified in the 2007 letter of appropriation:

1. Maintain effective safety requirements
2. Supervise licensee's responsibility for nuclear waste safety

Achievements in all these tasks has been assessed and reported back to the Government annually. For consultations before more complicated decisions have been taken, SKI has had three permanent advisory committees: one for reactor safety matters, one for nuclear fuel cycle matters and one for research and development matters. Each committee consists of a chair and six other members. The chairs were appointed by the Government and other members by the SKI Board for a limited time period.

The organisation was changed 1 January 2006. (See figure E.2). The earlier departments for nuclear waste safety and nuclear non-proliferation were merged into the nuclear materials and waste safety department. The new department is divided in three sections and a management group was created. An administrative department was also created with total responsibility for coordination of planning and follow-up of all activities including research activities. This department is divided in two sections and a legal secretariat. A staff unit was also created for the Director General consisting of three coordinators one for the management system, one for international relations and one for research strategy issues. The main reason for the change was to create better opportunities for meeting the upcoming regulatory challenges regarding the nuclear waste programme, decommissioning and safeguards.

From May 2007 a new section was established directly under the Director General dealing with financial issues related to decommissioning and handling of spent fuel and nuclear waste.

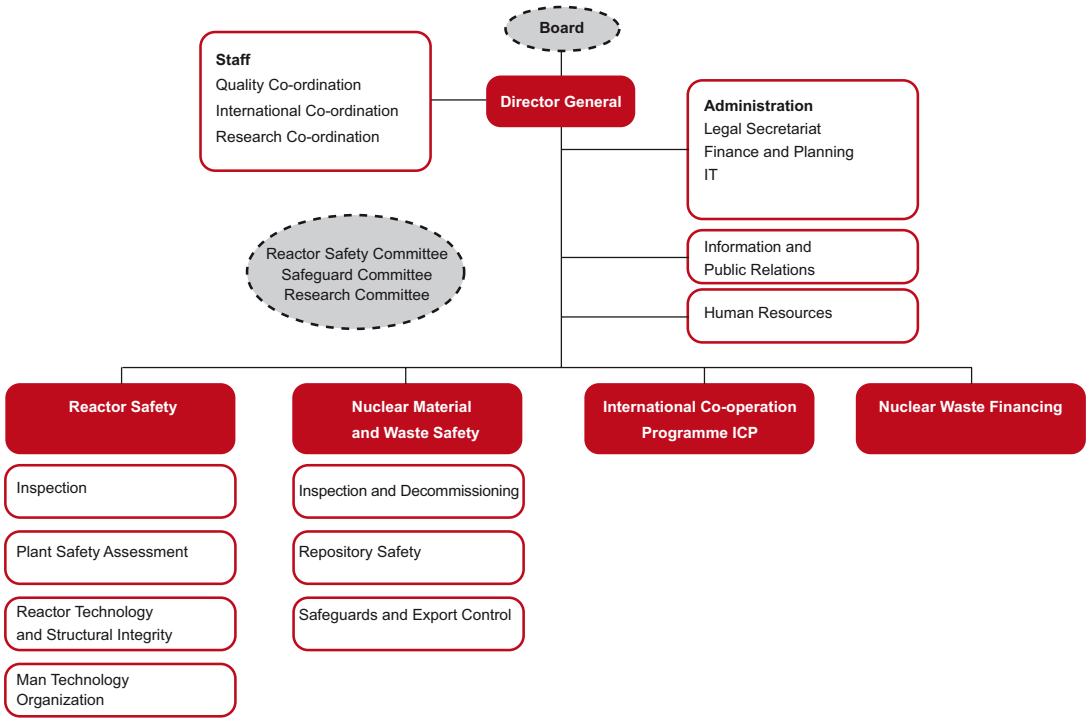

Figure E2: The former SKI organisation before the merger with SSI.

The Swedish Radiation Protection Authority (SSI)

The former Swedish Radiation Protection Authority's (SSI) missions and tasks was defined in the Ordinance (2006:524)[19] with instruction for the Radiation Protection Authority and in the annual letters of appropriation where the Government issues directives for the authorities including the use of appropriations.

SSI's mission was to promote effective radiation protection for people and the environment. For this purpose, SSI issued regulations and provided information, education, issued advice and recommendations, and funded and evaluated research.

In the letter of appropriation for SSI three activity goals are listed under the main objective: Nuclear Energy Supervision and Emergency Preparedness:

1. National emergency preparedness. It is pointed out that the Swedish national emergency preparedness of high class shall be maintained, developed and co-ordinated with Sweden's international responsibilities. SSI shall also co-ordinate the national competence regarding measurement techniques relevant for emergency preparedness issues.
2. Safe handling of radioactive waste, as well as limitation of emission of radioactive nuclides. Spent nuclear fuel and radioactive waste have to be managed and transported, from a radiation protection point-of-view, in safe way. The amount of radioactive waste and the emissions of radioactive substances shall be limited as far as reasonably achievable. Assessment, dialogue and information in connection with the on-going siting- and licensing process for a future repository for long-lived and high-level activity radioactive waste should be carried out in such a way that a good basis for decisions is achieved.
3. Protection of workers and public. A safe radiation environment for workers and the public has be upheld. Acute radiation effects should not occur and doses to workers and the public should be kept as low as reasonably achievable. SSI shall report how the work of the authority has contributed to good administrative control of radiation sources and has counteracted the risk for orphan sources.

SSI has also been tasked with reporting the effect on radiation protection of its research and development projects.

SSI was reorganised in 2006. The central authority work is performed within three main departments:

- Waste Management and Environment Protection
- Emergency Preparedness and Environmental Assessment
- Occupational and Medical Exposures

The National Metrology Institute for Ionising Radiation with its staff was organisationally placed within the Department of Occupational and Medical Exposure with separate financing and its quality management system follows the ISO-standard 17025:2005.

Two offices report directly to the Director General:

- Office of Communication;
- Office of Administration (Finance, Human Resources, IT, Legal Issues).

In addition to these offices there was a special programme for international radiation protection and emergency preparedness and response: the International Development Co-operation (SIUS). The programme was operationally independent from SSI but reported directly to the Director General. The unit administered Swedish radiation protection assistance and co-operates with mainly Central- and East European countries.

During 2006 the environmental work of SSI was certified according to ISO 14001. SSI activity plan for 2007 included instructions for the measures needed to achieve certification of SSI's quality management and work environment management systems according to relevant ISO-standards. Work with updating and completing existing SSI policy and routines has presently started.

[19] The Ordinance was replaced July 1, 2008, by the Ordinance (2008:452) with Instruction for the Swedish Radiation Safety Authority

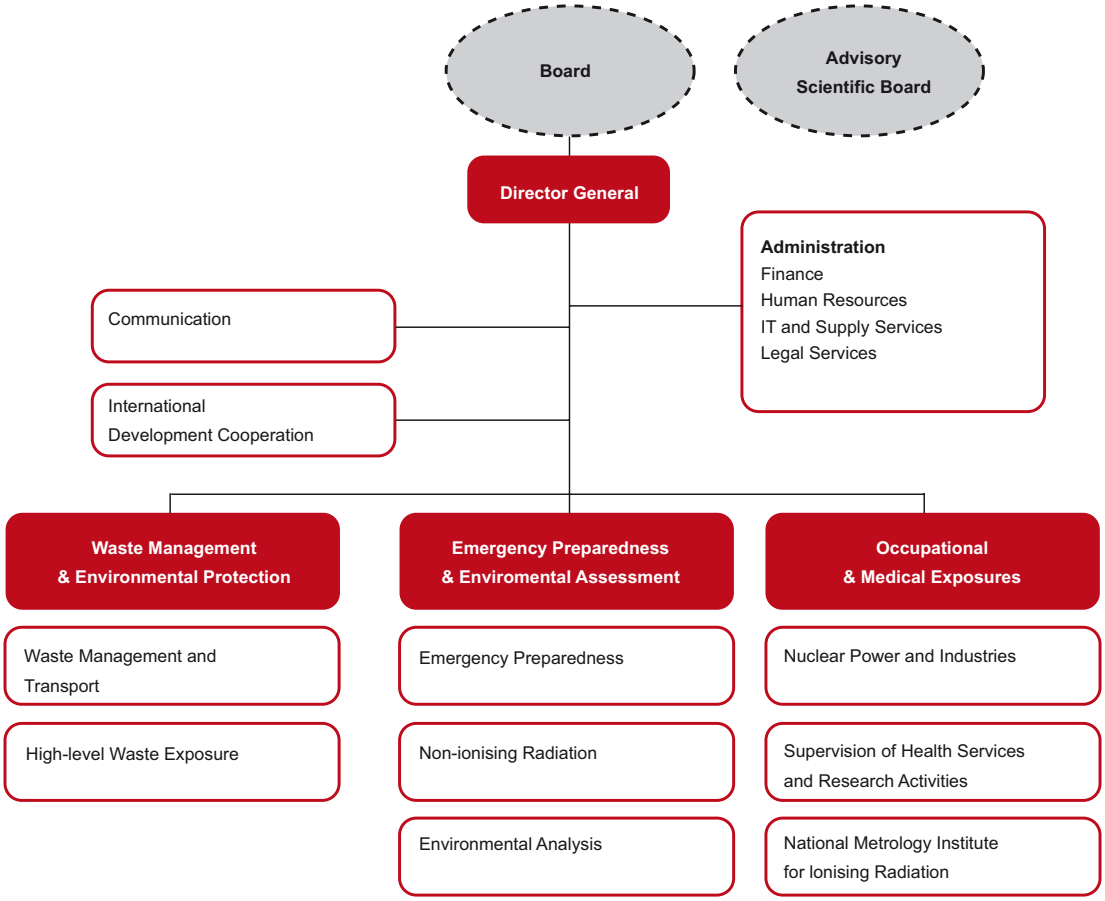

Figure E3: The former SSI organisation before the merger with SKI.

A Safe Radiation Environment – an environmental quality objective

The Swedish Parliament decided in November 2001 on objectives, measures and strategies aimed at achieving environmental quality objectives, as described in the Government's Bill 2000/01:130. There are currently sixteen environmental quality objectives with associated interim targets. One objective is defined as "A Safe Radiation Environment", which addresses both ionising and non-ionising radiation, with associated interim targets. The interim target concerning ionizing radiation was initially focused on means to reduce emissions from human activities so that radiation doses by 2010 should be limited as far as reasonably possible. The maximum public radiation exposure (absorbed dose) due to human activities should not exceed 1 mSv per person per year. The additional individual dose to members of the public should be lower than 0.01 mSv per person per year from each individual operation.

The environmental quality objectives and associated interim targets are evaluated at regular intervals. The Environmental Objectives Council's second in-depth evaluation in 2008 concluded that the interim target concerning ionising radiation should shift focus slightly, towards the area of radioactive waste management and disposal. One of the proposals from the Council in this respect is to increase efforts on developing systems for long-term preservation of information about final disposal facilities (repositories) for long-lived radioactive waste, including their location and contents.

E.3.2 Human and financial resources

E.3.2.1 Human resources

SKI had a staff of 130 (end of 2007). Of these, 18 were directly involved in regulating management of spent fuel and radioactive waste. With the exception of the administrative personnel, most of the SKI staff is comprised of professional scientists or engineers; seven persons have qualified behavioural science training.

At SSI 118 persons are employed (2004). Of these approximately 25 are occupied with matters in direct connection to the radioactive waste. Most of the staff is engineers and scientists in the area of physics and radiation physics. There are also physicians, biologists, lawyers, communication experts and administrative personnel.

The distribution of educational background in 2007 was as follows for SKI and SSI:

Educational background	Percentage of staff	
	SKI	SSI
Post graduate degree	19	29
Bachelor, master	57	51
Secondary high school	22	14
Other	2	6
Total	**100**	**100**

Table E1: The educational level of the SKI and SSI staff 2007.

SKI and SSI have on average had a higher level of education than other public and private administrative organizations in Sweden. The staffs of both authorities have a high level of technical and scientific competence, and enjoy high international esteem. About 25 % of the staffs have post-graduate degrees, and more than half of the staffs have graduated from university.

In 2007 the average length of employment at SKI was ten years, and about 35 % of the staff had been employed for more than 10 years. The average employment time at SKI is 10 years. 48% of the regulatory staff is older than 50 years, 22% is younger than 40 years. The average age is 48.5 years. 16% of the regulatory staff will reach 65 years of age, the official retirement age, within the next 5 years. The staff turnover rate excluding retirement was 5% during 2006, which is about normal.

The average length of employment at SSI is 13 years (2007), and almost half of the staff has been employed for more than 10 years. Of the total staff approximately 30 persons are occupied with matters in direct connection to the supervision of nuclear facilities. Some of these are scientists in the area of physics and radiation physics but there are also radio ecological physicians and biologists. Staff turnover in 2006 was 4%.

In the staff of both regulatory bodies there are also lawyers, IT-experts, information- and administrative personnel. At both authorities one inspector per site is designated as site-responsible, serving as the main contact point between the facility and the authority. At both authorities there is also a decision maker on duty 24 hours a day.

Due to a large number of employees retiring in the coming years at both authorities, concerns have been raised whether this might lead to a loss of adequate competence in the areas of safety and radiation protection. In 2003 a governmental committee stated that it will be taken well care of when it comes to safety issues, as SKI has both a mandate to promote research and education and the financial means to support research and higher education in this field. However, the committee pointed out that the situation in the radiation protection field is rather distressing. Therefore the government appointed SSI to investigate the situation concerning national radiation protection competence. SSI reported on the situation in December 2005 and gave suggestions on possible measures to be taken.

The investigation represents SSI's assessment of the needed competence during the next 15-year period. Additional resources should be allocated to higher education, especially in the threatened topics radiation biology and radioecology. This should include both means for advanced courses as well as for postgraduate research students. Already accounting for an announced strengthening of research funds of ten million SEK (see below), SSI proposed that additional funds should be allocated for three lectureships and five positions for postgraduate research and/or junior research fellowships, especially in radiation biology and radioecology.

In parallel with the SSI investigation the Government announced in its autumn budget 2005 that there is a need for strengthening radiation protection research in order to secure the national competence. It was suggested that SSI should receive an additional ten million SEK for financing basic and applied research in radiation protection. The new Government that took office 2006, also allocated, with the start 2007, ten million SEK of annual extra research funds to SSI for radiation protection research.

SSI will use six million SEK of the new research funds to finance advanced research positions in radiation protection and the remaining four million SEK to fund radiation protection research, the primary focus being on basic research and on maintaining competence. The six million SEK will be divided between three research positions, in radiation biology, radioecology and dosimetry, each attached with either an additional postgraduate research position or a postdoctorate research fellowship and basic resources for the research activities. Each research position will be for three years with a foreseen extension of an additional three years.

SKI has made an extensive planning and developed a strategy for the future recruitment of qualified staff. The needed types of competence have been defined and competence profiles have been developed for all functions. In order to manage retirements and knowledge transfer to a younger generation, some recruitments have been made earlier to allow a younger professional to work in parallel with a much experienced colleague. Decisions have been taken to extend this programme. For some years, ending mid 2007, there have been special funds available to governmental authorities for facilitating such generation change. Retirement age is now flexible between 61–67 years. This, together with possibilities for staff in these ages to reduce working time, has increased the possibilities to keep older staff and has extended the available time for the generation change.

As both authorities are knowledge-based organizations, relatively large resources have to be spent on personnel development, in order to maintain and develop competence. About 10 % of the working time is allocated to the development of individual competence.

Both authorities have one inspector per site designated as site-responsible, and who serves as the main contact person between the facility and the authority. The SSI inspectors are mainly concerned with occupational radiation protection, environmental monitoring and waste management related activities.

Internationally the numbers of regulatory staff in Sweden are quite small for the size of the nuclear programme. Each professional staff member is typically involved in several tasks, for instance 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 staff members per reactor, but also to consider the types of legal obligations put on the licensees and the different oversight practices.

E.3.2.2 Financial resources

The SKI and SSI regulatory activities are financed as part of the state budget. The Government considers proposals from the two authorities for activities during the next financial year, in the same way as for other agencies. The Government evaluates proposed activities, and the result of the evaluation is presented in the budget bill. Resources are allocated in the Government's letter of appropriation, prescribing in addition directives for the activities.

Contrary to what is normal for state budget financed agencies, the costs for the regulatory activities have a neutral impact on the state budget. The costs are paid by the nuclear facilities to the Government as regulatory, research and emergency preparedness fees.

Appropriations available to SKI and SSI shall cover administration costs and research costs. The resources available for 2004 are shown in table E3. Administration includes all costs for staff salaries and operational activities.

Appropriation	SKI total	SSI total
Administration	102 000	161 000
Research	75 000	20 000
Total	**177 000**	**181 000**

Table E2: The SKI and SSI budgets for 2007 in kSEK.

About 80 % of the SKI administration budget covers fixed costs, such as salaries and costs for premises, telecommunications, etc. The remaining 20 % covers the variable costs, mainly travelling and consultancy costs. About 60 % of the resources are estimated to be used for reactor and nuclear materials safety work; and about 5 % for information activities. The remainder is used for safeguards and nuclear waste safety work.

The research budget dedicated for research on the safe disposal of spent fuel and nuclear waste at SKI is used to contract university institutions and consultant companies, in Sweden and abroad. It is also used to contribute to some international projects (organised by OECD/NEA, IAEA and EU). Nearly all the research covers the final disposal of spent nuclear fuel. About 30 % is used for the engineered barrier system (canister and bentonite), and about the same amount for site investigation and chemistry. Safety assessment and models for radionuclide transport takes about 25 %. The remaining 15 % is used for research on cost estimates and risk communication.

In 2007, the spent fuel and waste disposal research expenditures at SKI were distributed over research programmes as shown in table E3.

Research programme	Expenditures 2007 (kSEK)
Safety assessment methodology	2 523
Spent fuel nuclide chemistry	1 938
Technical barriers	5 095
Site characterisation and natural barriers	8 957
Decommissioning	269
Risk communication	823
Total	**19 727**

Table E3: Breakdown of the research budget the safe disposal of spent fuel and nuclear waste at SKI.

The SSI research budget is used for research in all areas of radiation protection, relating to ionising radiation as well as non-ionising radiation. Approximately 40 % of the budget is used for research directly related to nuclear energy production, such as radioecology, radiation protection of power plant workers, emergency preparedness, nuclear waste matters, and questions related to risk perception and acceptance of waste disposal. 25 % of the budget is used for non-nuclear research, i.e. mainly medical and technical applications as well as for basic research of importance to all areas of radiation protection, mainly radiobiology.

Research programmes at SSI directly related to radioactive waste during 2007 is shown in table E4.

Research programme	Expenditures 2007 (kSEK)
Biosphere modelling	425
Regulatory support	1 126
Studies of geosphere/biosphere interface	522
Total	**2 073**

Table E4: Breakdown of the research budget for the Department of Waste Management and Environmental Protection at SSI 2004.

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 the regulatory function, as reported in section E.2, concentrate solely on nuclear safety and radiation protection. The regulatory body reports to the Ministry of Environment, which has nothing to do with the promotion or utilisation of nuclear energy. Such matters 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 Swedish Constitution. This is a matter for the Government, in plenum.

E.3.4 A new regulatory auhority

As described in the introduction (section A.5.2) the Nuclear Power Inspectorate (SKI) and the Radiation Protection Authority (SSI) was merged into a new regulatory authority, the Swedish Radiation Safety Authority. The new authority has been tasked with the responsibility and tasks from the former regulatory authorities SKI and SSI, and is since July 1, 2008, responsible for enforcing compliance with the nuclear safety and radiation protection legislation

E.3.5 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 and the decommissioning of nuclear installations and to advise the Government and certain authorities on these issues.. The Government has authorised the Minister of Environment to appoint the Chairman and up to ten other Members. The budget of the Council is decided by the Government and activities of the Council 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 instructions (Dir. 1992:72), the Council shall:

- present a report on the state of knowledge in the nuclear waste area every third year (the latest report was issued in 2004);
- present an independent review of the research and development programme for the disposal of spent nuclear fuel which the nuclear power utilities prepare once every three years; and
- act as an advisory committee - upon request - to SKI and SSI on matters connected with nuclear waste and the decommissioning of nuclear power plants.

Besides technical seminars, the Council also arranges seminars with the aim of opening up a dialogue between different interest groups that are seriously interested in nuclear waste-related issues.

In the autumn of 2006 the Council launched a transparency programme. The purpose of the programme is to contribute to an increase in knowledge, and to strengthen the Council's role as an advisor to the Government by having strategic issues investigated in detail. The programme should also be a resource for other interested parties.

E.3.6 Conclusion

Sweden complies with the obligations of Article 20.

Section F - Other General Safety Provisions

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.

Summary of developments since the last national report

- A minor amendment has been made in the Act on Nuclear Activities concerning the responsibilities of the licensee.

F.1.1 Regulatory requirements

F.1.1.1 The prime responsibility

The Act on Nuclear Activities is very clear about the prime responsibility for safety.
10 § of the Act specifies that the holder of a licence shall be responsible for ensuring that all measures are taken which are needed for:

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

This paragraph was amended 2006 with the following:

- The licensee shall, in connection with accidents, threats or other similar circumstances, without delay give the responsible authority such information that is important for the assessment of safety.

In the pre-work to the Act it is stated that the licensee shall not only take measures to maintain safety but also measures to improve safety where this is justified.

It is stated in the annual government letter of appropriation that SKI requirements have to be clear with regard to the design of the plants and the obligations of the licensees regarding activities of importance to safety as well as the organisation and competence of staff. Regulations shall be outlined in such a way that the responsibility of the licensees are not negatively affected or is taken over by the state.

The regulatory authority's supervision shall ensure that the licensees have good control over the safety of the plants and that safety work is conducted with a satisfactory quality.

The general regulations concerning safety in nuclear facilities (SKIFS 2004:1) 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 (Chapter 2, § 9 point 8) 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 develops according to valid objectives and strategies.

The meaning of this is that a continuous preventive safety work is legally required, including safety 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 (Chapter 2, § 10).

The general regulations contain three basic control principles, making the roles clear between licensee and regulator:

- Approval by SKI (in specified matters) after primary and independent safety review by the licensee.
- Notification of SKI (in specified matters) after primary and independent safety review by the licensee.
- Self inspection by the licensee according to the own management system.

The basic safety documentation (SAR including OLCs[20]), plans for emergency response and physical protection) has to be approved by SKI. Plant and organisational modifications and changes in the safety documentation have to be notified and SKI can if needed impose additional conditions and requirements. All other issues are handled under the self inspection of the licensee. SKI inspects how this responsibility is taken.

According to the Radiation Protection Act the licence holder has to take the measures and precautions necessary to prevent or counteract injury to human health and the environment. 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 Regulations on Dose Limits at Work with Ionising Radiation (SSI FS 1998:4) stipulates limitation of radiation doses to workers and the general public at practices with ionising radiation. Anyone who conducts a practice with ionising 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 optimised 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 regulations are further explained in section F.4.1.1)

F.1.1.2 The ultimate responsibility

The State has an obvious overall responsibility for activities regulated in the Act on Nuclear Activities. Thus, the ultimate responsibility for ensuring the safety of spent fuel and radioactive waste rests with the State. According to a Government statement, the final responsibility of the State ”is a matter of course”. No further clarification of the State responsibility is therefore considered necessary in the legislation.

F.1.2 Measures taken by the license holder

SKB is the licensee for Clab and SFR. Clab is situated at the Oskarshamn site and SKB has therefore had an agreement with OKG for operation of the facility. SKB decided in 2005 to take over the operation of Clab and integrate the operating organisation of the facility into the SKB organisation. One of the main reasons is that SKB needs to secure and broaden competence for operation of nuclear facilities. This is especially important with regards to the construction and future operation of the encapsulation plant and the repository for spent nuclear fuel. The regulatory authority approved the organisational change and SKB took over the operation of Clab in January 2007.

SFR is situated at the Forsmark site and SKB has therefore made an agreement with FKA for the operation of the facility. The management system for SFR is therefore fully integrated with the management system for the operation of the NPP’s at Forsmark. In addition to the regulatory review of the overall management and performance of FKA, SKB reviews and audits FKA regarding the management of and SFR.

SKB has personnel specifically assigned to ensure that operation of SFR is performed in accordance with the agreement with FKA, and that the performance of FKA is according to relevant regulatory requirements, especially regarding radioactive waste management.

SKB also reviews all NPP organisations with regard to their fulfilment of regulatory requirements regarding waste generation and conditioning.

F.1.3 Regulatory control

In the 1998 letter of appropriation the Government confirmed a revision of SKI’s mission and regulatory tasks, in order to make the division of roles between the regulatory authority and the licensees clearer. It was stated in the directives from the Government that it is a fundamental prerequisite for the SKI activities that the licensees have the full and undivided responsibility for safety. The basic missions of SKI are to define the contents of this safety responsibility, and to supervise how the licensees execute it.

For this SKI shall in particular:

- provide a clear definition of requirements,
- check compliance with requirements by supervision focusing on processes and activities, and
- initiate safety improvements.

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[20] Operational Limits and Conditions

In the Government's letter of appropriation (2008) for SSI it is stated that operation of activities involving radiation (e.g. nuclear activities, waste management and decommissioning) shall be conducted in a way that a safe radiation protection environment can be established in relation to workers and the public. SSI shall annually report to the Government on the regulatory and research measures taken by the authority in order to estimate and limit the risks in the treatment and the final disposal of the spent fuel and radioactive waste.

F.1.3.1 Provide a clear definition of requirements

Previously individual licensing conditions for nuclear facilities has been replaced by general regulations in the Regulations Concerning Safety in Certain Nuclear Facilities (SKIFS 2004:1). These regulations apply to most nuclear facilities, describe principals and are functional in order not to have a negative impact on licensee responsibility. Details about the regulations are provided in section E.2.

F.1.3.2 Compliance check by reviewing activities focusing on processes and activities

SKI's review activities have been focused on processes and activities as it has been considered the most cost-effective way to assess that the licensees have a fully satisfactory control over safety as displayed in plant and organizational processes. For this purpose the inspection instruments described in section E.2.2.4, and the assessment instruments described in section E.2.2.2 have been adapted. A prerequisite for this type of review is that SKI clearly defines the controls necessary, in terms of licensee internal control functions, accredited third party control in some cases and, for issues of major safety significance, SKI review and approval. The regulatory strategy is based on internal guidance documents in the internal management quality system.

F.1.3.3 Initiate safety improvements

Regulatory review focusing on processes and activities means that SKI will not spend as much resources as earlier on in-depth reviews of technical issues, unless it is obviously needed in connection with licensing decisions. However, in order to identify safety improvement possibilities, it is necessary to have an extensive analysis and feedback of operating experience. Continued improvements and strengthening of these efforts have takes place both within SKI and the utilities.

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.

Summary of developments since the last national report
- The Act (2006:647) and Ordinance (2007:161) on Financing of Management of Residual Products from Nuclear Activities has replaced the Act (1992:1537) and Ordinance (1981:671) on the Financing of Future Expenses for Spent Nuclear Fuel etc.
- SKB has taken over operation of the Central Interim Storage for Spent Nuclear Fuel (Clab)

F.2.1 Regulatory requirements

F.2.1.1 Qualified staff during the operation lifetime

The general safety regulations concerning safety in nuclear facilities (SKIFS 2004:1) 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 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 Financing of Management of Residual Products from Nuclear Activities as described in section E.2.1.4. 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 repository 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 Financing of 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, final 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 Nuclear Activities Act 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 holder

SKB activities are developed and 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, which was previously contracted out to OKG. (see also section F.1.2).

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 fulfil 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.2.1.4).

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. SKI 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, SKI 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 (SKIFS). Beside the new area of responsibility within the organisation the number of staff increased from about 220 to 300.

Adequate financial resources

The regulatory authority assigned by the Government reviews the licensees cost estimates according to the Act on Financing of Management of Residual Products from Nuclear Activities. Furthermore, the regulatory authority 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, the regulatory authority 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. After reviewing the cost estimates of the licensees of nuclear facilities other than nuclear power reactors, the regulatory authority sets the fees and guarantees for the following three years.

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 SKIFS 2004:1 (chaper 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 a total management system, is in line with the recently issued IAEA Safety Requirements on Management Systems, GS-R-3.

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 form 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

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 authorities. 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 has been 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 organisation and daily work.

Quality system implementation and quality audit programmes
Every Swedish NPP 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. SKB is the licensee for Clab and SFR as described in section F.1.2. SKB has made an agreement with FKA for the operation of SFR. SKB therefore review and audit the organisation regarding management of SFR. Being responsible for the long-term safety of SFR, SKB also reviews all NPP companies with regard to fulfilment of regulatory requirements concerning waste generation and conditioning.

Quality audits of suppliers
According to the requirements on quality assurance in the general regulations SKIFS 2004:1, all purchases of goods and services which might have an affect, 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.

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 organisation. 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

SKI's own quality system has included guidance for SKI-staff when reviewing the licensees' quality systems. Usually the quality system itself has not been the only target for SKI's review and inspections. Appropriate aspects of the application of quality assurance are included in all SKI 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.

SKI 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 SKI.

In general SKI 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 radioactive 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 radiation doses which exceed national prescriptions for dose limitation 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 achievable, economic and socialfactors 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 internationally 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 radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

F.4.1 Regulatory requirements

F.4.1.1 Regulatory requirements on occupational radiation protection

To ensure low radiation exposure from nuclear facilities, including facilities for the management of spent fuel or radioactive waste, Sweden has a number of regulatory requirements. Fundamental radiation protection requirements for workers and the public are given in the following SSI regulations.

SSI FS 1998:4 Regulations on Dose Limits at Work with Ionising Radiation

The regulations apply to limitation of radiation doses to workers and the general public at practices with ionising radiation. The regulations also apply to the protection of pregnant women that may be exposed to ionising radiation in their work. In the general obligations it is stipulated that anyone who conducts a practice with ionising 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 are optimised, 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.

For workers in general the annual effective dose limit is 50 mSv. In addition, for five consecutive years the effective dose limit is 100 mSv. A pregnant woman has the right to be transferred to work that does not imply exposure to ionising radiation during the remaining time of pregnancy. Should she choose to remain to her ordinary work, the work shall be planned in such a way that the equivalent dose to the foetus becomes as small as reasonably achievable and that it is unlikely that it exceeds 1 mSv during the remaining period of pregnancy.

Concerning the general public the sum of the dose contributions from practices with ionising radiation shall not exceed:

- 1 mSv annual effective dose;
- 15 mSv annual equivalent dose to the lens of the eye; or
- 50 mSv annual equivalent dose to the skin evaluated as the mean equivalent dose over an area of 1 cm^2 regardless of the size of the exposed area.

Effective dose is defined as the sum of all equivalent doses to organs or tissues, weighted for their different sensitivity for radiation. Equivalent dose is defined as an absorbed dose to an organ or tissue, weighted by factors taking into account the biological efficiency of the kind of radiation. SSI takes the dose limits into account when judging conditions for licences. As several practices may contribute to the exposure of an individual, specified regulations or conditions are given for the various practices.

SSI FS 1998:5 Regulations on Monitoring and Reporting of Individual Radiation Doses
These regulations apply to measurements of individual radiation doses to workers of category A working with ionising radiation and reporting of doses received to the National Dose Database. Some procedural changes for accreditation of laboratories for individual dose monitoring were introduced in the regulations SSI FS 2003:2 (Amendments to the Regulations SSI FS 1998:5).

SSI FS 1996:3 Regulations on Outside Workers at Work with Ionising Radiation
The regulations apply to outside workers of category A working within controlled areas in Sweden and on cases when Swedish workers of category A perform similar tasks in other countries. Category A and controlled area are defined below in SSI FS 1998:3.

SSI FS 1998:6 Regulations on Medical Examinations for Radiological Activities
These regulations are general and apply to all kinds of category A workers.

SSI FS 1998:3 Regulations on Categorization of Workplaces and Workers at Work with Ionising Radiation
The regulations apply to practices with ionising radiation where humans may get radiation doses such that:
- the annual effective dose exceeds 1 mSv;
- the annual equivalent dose to the lens of the eye exceeds 15 mSv; or
- the annual equivalent dose to the hands, forearms or the skin exceeds 50 mSv.

Anyone who runs a practice shall classify the workers into category A or B. A worker shall belong to category A if the likelihood is not negligible that:
- the annual effective dose exceeds 6 mSv;
- the annual equivalent dose to the lens of the eye exceeds 45 mSv; or
- the annual equivalent dose to the hands, forearms or the skin exceeds 150 mSv.

Workers not belonging to category A shall belong to category B. For those workers surveillance of doses shall be performed to such an extent that it is possible to demonstrate that this classification is correct.

A workplace where the workers may get any of the annual doses pointed out above or from which radioactive contamination may be spread shall be a controlled area. A controlled area shall be delineated and access restricted to authorised persons, i.e. persons who have been sufficiently trained.

With all the above regulations as a basis, two regulations specially directed towards nuclear facilities have been formulated:

SSI FS 2000:11 Regulations on Radiation Protection Manager at Nuclear Facilities
According to these regulations a license holder shall appoint a radiation protection manager at the facility in order to implement and look after radiation protection conditions issued by the authorities.

SSI FS 2000:10 Regulations on Radiation Protection of Workers Exposed to Ionising Radiation at Nuclear Facilities
These regulations apply to the radiation protection of workers at nuclear facilities and regulate several different areas; optimisation, education, demands on local procedures, controlled areas, personal radiation surveillance, procedures connected to fuel elements, reporting and documentation.

The Swedish occupational radiation protection requirements aimed at the nuclear facilities are similar to those of other EU Member States. The most important requirements in SSI FS 2000:11 and SSI FS 2000:10 are listed below.

General requirements and dose limits
Anyone who conducts a practice with ionising 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 are optimised by which is meant that human exposures are as low as reasonably achievable social and economic factors taken into account, and
- no radiation dose limit is exceeded

Limits for workers regarding effective dose and equivalent dose per calendar year are as follows (SSI FS 1998:4):

Effective dose	50 mSv
Equivalent dose to the lens of the eye	150 mSv
Equivalent dose to skin, hands and feet	500 mSv

In addition, during five (5) consecutive years, the total effective dose shall not exceed 100 mSv

The regulations also stipulate special rights for breast-feeding or pregnant women to be transferred to work that do not imply risk of internal contamination with radioactive substances or exposure to ionising radiation. If a pregnant woman remains at her ordinary work, the work shall be planned in such a way that the equivalent dose to the foetus becomes as small as reasonably achievable and that it is unlikely that it exceeds one (1) mSv during the remaining period of pregnancy.

Medical examination
A medical examination for radiological activities is required at least every third year. The employee must each year arrange with a new doctor's certificate as proof of that he/she is fit for service. The medical doctor issues this certificate based on a specified medical examination or, which is allowed in the intervening years, on a health declaration filled out and signed by the employee.

Supervised and controlled areas
The surveillance of workplaces shall be made using suitable methods with respect to present kinds of radiation, energies and the physical and chemical properties of radioactive substances. The results shall be recorded and, if necessary, provide possibilities to calculate individual radiation doses.

Workplaces and premises where persons might receive an effective radiation dose, resulting from the radiological activities; exceeding one (1) mSv shall be classified as supervised area. The supervised areas must be marked and instructions for work in such areas are required. If there is a risk for spread of radioactive contamination or the annual effective dose can exceed six (6) mSv, taking into account the risk of mistakes and accidents, the workplace/premises shall be classified as a controlled area. The access to controlled area is restricted and special education is required. Persons working in a controlled area shall wear a personal dosimeter. It shall be forbidden to smoke or consume food in controlled areas.

Anyone who runs a practice shall for each controlled area lay down local instructions, in written, about how the work should be performed and what protective measures should be taken by those who work in the area. The instructions shall be adjusted according to the kind of work and the radiation sources and shall be available at the workplace.

If radioactive substances may contaminate surrounding areas, the operator shall introduce the necessary measures to prevent the spread of contamination outside of the controlled area. When exiting the controlled area, all persons shall be monitored for external radioactive contamination.

Within a controlled area, premises and places shall be specially marked and admittance restricted, if the risk of receiving a yearly effective dose exceeding 50 mSv in these places is not negligible.

Information and education
All personnel, permanent staff and contractors, shall be informed about radiation protection prior to work within a controlled area. Repetitive information shall be given at least every third year. The regulation system uses a graded approach; i.e. extra radiation protection education is required for personnel working with radiation protection issues, personnel working with operation and maintenance and contractors in charge of work management. The training shall be adjusted to the scope and type of the performed work and to the existing radiological working environment.

Personal dose monitoring
All personnel including contractors, on entering a controlled area, shall carry a personal dosimeter that fulfils certain requirements. Before leaving the controlled area, they shall be monitored for external radioactive contamination. All persons for which there is suspicion or confirmation of internal contamination with radioactive substances shall be measured in a whole-body counting system so that the committed effective dose can be estimated.

Optimisation
The work shall be performed in such a way that human exposures are limited as far as reasonably achievable, economical and social factors being taken into account. For this purpose, the licence-holder shall ensure that documented goals and actions for the optimisation work are established and that necessary resources are available in order to perform the actions and work towards the established goals.

Site-specific instructions concerning radiation protection
The licence-holder shall ensure that site-specific instructions for radiation protection are established.

Visitors
Visitors from the public are allowed in a controlled area if guided by designated persons and a prearranged visit plan is followed. Visitors to controlled areas must be at least 14 years old.

Instruments and equipment
All instruments used for radiation protection and the control of radiation doses shall be calibrated and undergo regular functional checks. The dose rates in the calibration set-up shall at least every second year be checked towards an instrument that is calibrated at a test-house that is accredited for ionising radiation. Alternatively, the instrument may be calibrated directly at an accredited test-house.

Transport within the facility
All transport of radioactive substances within the industrial area shall with regard to the requirements on dose rate, surface contamination or the transportation package, as far as is practical, follow the international regulations regarding the transport of hazardous goods on roads.

Work with irradiated fuel elements
Work with dismantling irradiated fuel elements in the reactor pool, when individual fuel rods are handled, must not take place earlier than five days after the reactor is put into the cold shut down mode. During work with fuel rods only persons directly involved may be present in the area. The air shall continuously be monitored for air-borne and gaseous radionuclides during this type of fuel dismantling work. Documented instructions for alarms and evacuation of the premises shall be developed. The content of these instructions shall be well known by all persons working on the premises.

Policy in the event of fuel failures
A documented policy for the event of fuel failures shall be established at all facilities where nuclear reactors are involved. The policy shall include a description of the facility's strategy for avoiding fuel failures as far as reasonably possible. In addition, there shall be a strategy for how to handle a situation if fuel failure occurs.

Reporting to SSI
An annual written report shall be sent to SSI that contains a compilation of the radiation doses to personnel as well as the results of the radiation surveillance outside the controlled area.

Any work for which the total collective dose is expected to exceed 100 mmanSv shall be reported in writing to SSI in advance. No later than 3 months after the work for which the total collective dose has exceeded 100 mmanSv is finished, a written report shall be sent to SSI that includes the experience obtained concerning radiation protection matters.

Any internal contamination occurring, in one single event, which is estimated to result in a committed effective dose, exceeding five (5) mSv shall be promptly reported to SSI after discovery. The report shall include the type of intake, the estimated committed effective dose and the basis for the calculations, as well as the cause and circumstances of the internal contamination.

If there has been an event that led to, or could have led to, that any given dose limit (SSI FS 1998:4) was exceeded, a report shall promptly be sent to SSI.

Documentation and filing of measurement data
Primary data on the evaluation of individual radiation doses due to external as well as internal exposure shall be kept at least one year after the calendar year in which the measurements were made. From the results of these evaluations, it shall be possible to correlate a measured dose to the person that received that dose. The final dose results shall be available in a central national dose register that is approved by SSI. The dose records shall be kept until a person have reached 75 years, however at least until 30 years after work with ionising radiation has stopped.

Radiation protection manager
The licensee shall appoint a radiation protection manger. This person shall be approved by SSI and have sufficient competence in matters related to radiation protection.

SSI has commenced the work to update some of the existing radiation protection regulations. Areas that are reviewed and where changes in the existing requirements are planned are the radiation protection organisation, radiation management programmes, including internal reviews, and the radiation protection education.

Both SSI and the nuclear industry have studied the effects on radiation protection of the planned, and already partly implemented, power uprates at some Swedish nuclear power plants. SSI has tasked an international consortium to make an inquiry into the radiological consequences of power uprates at light water rectors worldwide. The study was finished 2007 (SSI report 2007:07).

F.4.1.2 Environmental radiation protection
The first general regulations concerning the limitation of releases of radioactive substances from nuclear power plants were issued in 1977. Minor revisions of the regulations have been made during the period that the regulations have been in use (SSI FS 1991:5).

A major revision was made in 1999-2000. The present regulations (SSI FS 2000:12) concerning protection of human health and the environment from releases of radioactive substances from certain nuclear facilities entered into force on 1 January 2002.

The regulations apply for nuclear power reactors, research reactors, fuel fabrication facilities, storages for spent fuel and waste disposal facilities during their operational phase (shallow land burial sites are excluded). The previous regulations were only applicable for nuclear power plants. Other facilities were regulated separately but basically in the same manner.

Purpose of the release regulations
The main purpose with the new regulations is to limit and reduce the releases of radionuclides from nuclear facilities. The limitation of releases of radioactive substances from nuclear facilities shall be based on optimisation of radiation protection and use of the best available technique.

Dose constraints and critical group

According to the regulations SSI FS 1998:4 the dose limit for members of the public is 1 mSv per year from all contributing artificial radiation sources. This limit is also in accordance with EU BSS. Taking into consideration that an individual may be affected by dose contributions from more than one facility/source, a dose constraint for a particular site is set to 0.1 mSv per year in the release regulations (SSI FS 2000:12). This means that the facility has to show that the doses from releases are below 0.1 mSv per year to the most affected individuals, the critical group.

When taking into account that some of the radionuclides will be present in the environment for a long time, it is important to compare the dose constraint of 0.1 mSv with the dose commitment from a yearly release, rather than with the dose from the release. SSI has chosen to set the integration time to 50 years when calculating the dose commitment. When the calculated dose is 0.01 mSv or more per calendar year, realistic calculations of radiation doses shall be conducted for the most affected area. These calculations shall be based on measured dispersion data and knowledge about the most affected area.

Release limits

No formally defined nuclide specific release limitations have yet been defined. Limitation is being implemented through the restriction of dose to the critical group. Thus, for each nuclear facility and for each radionuclide that could be potentially released, site-specific release-to-dose values have been established. These values have been calculated for hypothetical critical groups, and take into consideration reasonably realistic local dispersion conditions, as well as assumptions on diet and the contribution of locally produced foodstuff to the diet of the group.

Use of best available technique

The best available technique (BAT) shall be used for reducing releases at nuclear facilities. BAT is defined as the most effective measure available to limit the release of radioactive substances and the harmful effects of the releases on human health and the environment, which does not entail unreasonable costs. For nuclear power reactors in particular, two new concepts, reference and target values, have been introduced.

A reference value is a value for the release of individual radionuclides, or groups of radionuclides that indicate the optimal operation of the reactor in terms of performance and management of systems of importance for the generation, elimination or delay of releases into the environment. Nuclide(s) should be chosen on the basis of, e.g., impact or indicative function for abatement system performance. The operator is responsible for formulation of reference values for a specified time, and these are to be scrutinized by SSI.

A target value will define the ambition of the operator in terms of release limitation, taking into account, inter alia, the best available technique. The target value is to be defined by the operator, as well as the time frame within which the operator plans to reach the target.

All releases of radioactive substances to the environment shall be measured. In particular, releases to the atmosphere via the main stacks of nuclear power reactors shall be controlled through continuous nuclide-specific measurements of volatile radioactive substances such as noble gases, continuously collected samples of iodine and particle-bound radioactive substances, as well as the measurements of carbon-14 and tritium.

Releases to water shall be controlled through the measurements of representative samples for 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.

Environmental monitoring shall be conducted in the area surrounding a nuclear facility in accordance with a programme formulated by the regulatory authority.

According to the regulations, quality assurance and documentation of environmental monitoring shall be provided in accordance with the principles of the ISO 9000.

Reporting

The nuclear power reactor licence-holders shall report to the regulatory authority annually the measures that have been adopted, or that are planned to be adopted, to limit radioactive releases with the aim of achieving the specified target value. If reference values are exceeded, the measures that are planned 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 semi-annually to the regulatory authority. The report concerning the second half of the year shall, at the same time, constitute the annual report.

Events leading to increased releases of radioactive substances from nuclear facilities shall be reported as soon as possible to the regulatory authority, describing the measures adopted to mitigate the releases. In particular, in the event of the release of radioactive substances to air or water, which results in a dose to any individual in the critical group exceeding 10 microsievert per month or if results from environmental monitoring show abnormally large quantities of radioactive substances, the regulatory

authority shall be notified immediately. In addition, for nuclear power reactors, plans of action shall exist to limit the release of radioactive substances that can arise in the event of fuel failures. The strategy for avoiding the occurrence of fuel failures and the measures planned to limit radioactive releases to the environment in the event of a fuel failure shall be described in the plans. Depending on the situation, the regulatory authority can issue additional regulations.

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 optimised.

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 doses to the personnel at Clab reported between 1998 and 2007 are shown in figure F1.

No open radiation sources are handled at the final repository for low and intermediate level waste (SFR) and all radioactive waste is conditioned. Thus, the doses to the personnel originate from external radiation. Contamination of transport casks and waste packages has never occurred to the extent that any airborne radioactivity has been measured. The yearly doses to the personnel at SFR are very low. There are some variations depending upon whether waste packages have been covered with cement during the year or not. The doses to the personnel since 1988 (when SFR was taken into operation) until 2007 have been about 25 mmanSv. This gives a yearly average dose of less than 2 mmanSv.

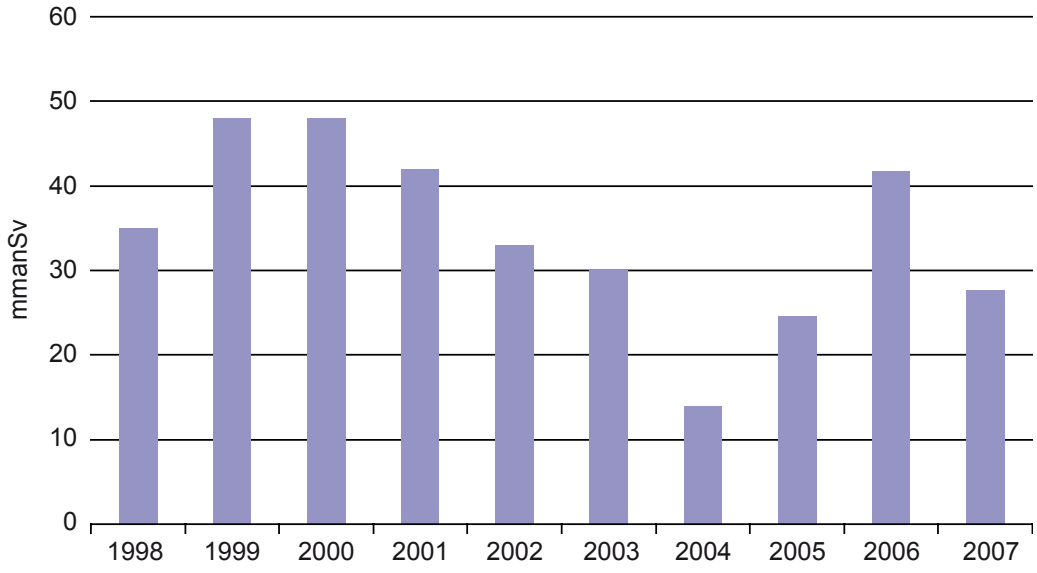

Figure F1: Doses to the personnel at Clab 1998-2007.

Studsvik operates several facilities for treatment of radioactive waste. For 2007 they reported a yearly dose of 35 mmanSv and an average dose of 1.1 mSv. Ranstad Mineral recycles uranium mainly from the fuel fabrication activities at Westinghouse Electric Sweden AB. The doses reported by Ranstad Mineral for 2007 are a yearly dose of 4.1mmanSv and an average dose of 0.8 mSv.

For the personnel that work with waste handling at Westinghouse Electric Sweden AB fuel factory the individual doses are below 1.0 mSv.

F.4.2.2 Radiation doses from releases to the environment

Figure F2 shows the radiation doses related to all releases from nuclear power plants and other nuclear facilities for the years 2002-2007. Generally, the resulting doses to individuals in the public are less than 1% of the limit, except for one site (Ringhals) where the resulting dose during the 1990s has been considerably higher. The main reason for this is a combination of uranium contamination on system surfaces and the short delay time for the effluents (in the BWR). However, through installation of new abatement systems and a successive clean-up of the primary system the releases from the Ringhals site are now reduced to a level where the dominating dose contribution instead comes from carbon-14 (in PWR), see figure F2.

From the available release data it is not possible to single out releases from the radioactive waste handling at the nuclear power plants. The releases from Clab are included in the releases from Oskarshamn NPP. From SFR releases to the air and water are measured. The releases are reported as part of the total release from Forsmark NPP and constitute a small part of this release. Ranstad Mineral reported a release of 0.04 microSv for 2007. From Ågesta small amounts of H-3 is released from the drainage of the rock chamber where the shut down reactor is situated.

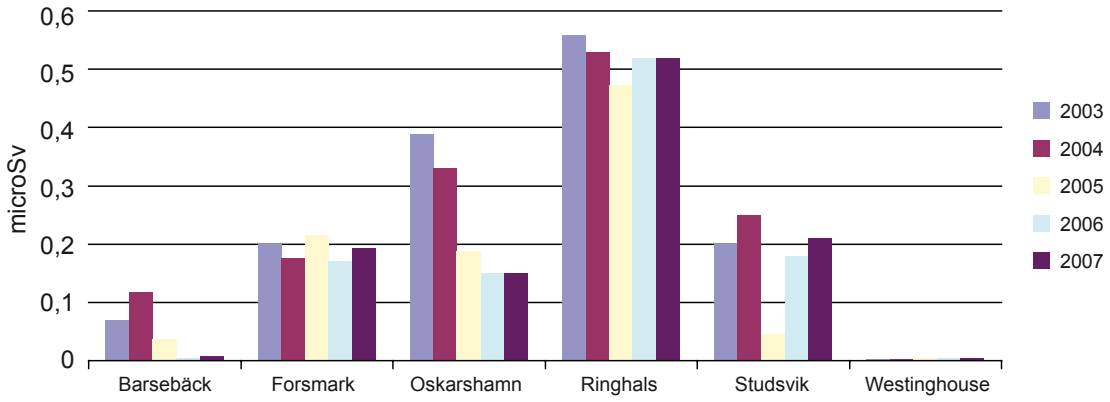

Figure F2: Radiation doses to individuals in the critical group from releases 2003-2007.

F.4.3 Regulatory control

See Section E.2.2.3

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.

The emergency plans for all nuclear power plants and Studsvik include the installations for spent fuel and radioactive waste management at these facilities. The Clab and SFR facilities are included in the emergency plans for the nuclear power plants OKG and Forsmark respectively. The fuel fabrication facility Westinghouse Electric Sweden AB also has an emergency plan.

F.5.1 Regulatory requirements

In the Government bill 1980/81:90, issued after the Three Mile Island accident, the emergency preparedness issues received considerable attention. It was proposed by the Government, and decided by Parliament, that the emergency planning must consider all types of accidents, from those with very small environmental consequences to the most serious accidents. Further, systematic training of decision-makers must be undertaken as well as the organization of personnel on duty and a system for verified telecommunication between the responsible organizations. Finally it was required that technical support centres to the control rooms of the nuclear power plants should be established.

SSI's role have been to maintain and further develop the national radiation protection preparedness. The preparedness should be assessed in national and international exercises, and shall be co-ordinated in accordance with international treaties. Moreover, SSI have co-ordinated the national resources for radiation measurements, and have maintained responsibility for the operation of air filter stations. All these obligations are stated in the Civil Protection Act (2003:778), the Civil Protection Ordinance (2003:779) and in the Ordinance with instructions for SSI (1988:295). Furthermore SSI and SKI have had a role when it comes to society's emergency management through the Emergency Preparedness Ordinance (2002:472). Several authorities are jointly responsible for planning and co-ordinating security and emergency measures.

The development and practice of an on-site emergency preparedness plan is a licensing condition. This requirement is specified in the general safety regulations (SKIFS 2004:1) and in Regulations on Emergency Planning at certain Nuclear Facilities (SSI FS 2005:2). The regulations are applicable to spent fuel and radioactive waste management facilities as well as to nuclear power plants and nuclear fuel production facilities.

It is required of the licence-holders that in case of incidents that could lead to a radiological accident, there are plans for:

- alerting the emergency preparedness personnel without delay;
- bringing the plant to a safe and stable state;
- ascertaining personnel safety; and
- providing information about the technical and radiological situation at the plant.

The plan shall be kept up to date and tested in regular exercises. It is further required that there are specially assigned and trained personnel, suitable emergency operating centres, technical systems, tools and protective equipment to the extent needed to carry out the tasks mentioned. Further details about planning conditions are given in the general recommendations to the regulations.

In the Civil Protection Act and Ordinance it is stated that a county is responsible for the protection of and information to the citizens living there in the event of a nuclear accident of any kind. The Swedish Rescue Services Agency has also issued requirements on alarming and informing the public.

Sweden has signed the Convention of Assistance in the Case of a Nuclear Accident or Radiological Emergency and the Convention of Early Notification of a Nuclear Accident. Sweden has in addition made several bilateral agreements concerning information in the event of an accident. These conventions and bilateral agreements apply to all nuclear facilities, including facilities for the management of spent nuclear fuel or radioactive waste.

The licence-holders are required to carry out exercises every year. In addition to internal exercises and drills a nuclear power plant has a comprehensive national exercise together with the county and central authorities every eighth year, to check the emergency plans and the capability of the on-site and off-site organisations. These exercises are planned by the respective county administration and are evaluated by the Rescue Services Agency. Some 15 to 30 organisations usually participate in these exercises. SSI and SKI have participated in the planning, the exercises, and in the evaluation process.

F.5.2 National monitoring and measuring[21]

A network of permanent radiation monitoring stations (SSI gamma stations) has been in operation since the end of the 1950s. After the Chernobyl accident, the number of monitoring stations was increased from 25 to 37, and data transmission to SSI via modems and telephone lines was introduced. The stations are designed to initiate an alarm in the event of elevated radiation levels. All components of the system are now out of date and the entire monitoring system must be replaced or upgraded. Due to this, only 32 stations are in operation at present. A decision to purchase a completely new system has been made, and a specification for offers is being prepared. The number of monitoring stations will be similar to the present system. The network of automatic weather stations will be used for the localisation of the new station network. The Swedish Defence Research Agency is contracted to keep six air filter stations in operation, including analysis of the air filter samples. SSI has made an agreement with the Swedish Meteorological and Hydrological Institute for continual dispersion forecasts and handling of international alarms (National Warning Point). The dispersion forecasts for hypothetical emissions are calculated every six hours for all Swedish nuclear power plants and for a number of nuclear power plants in neighbouring countries. The forecasts are continuously available at SSI.

The Swedish radiation monitoring resources consist of the laboratory at SSI and nine other laboratories under contract with SSI. The nuclear power plants participate in the national preparedness on a voluntary basis. The laboratories under contract are obliged to maintain a preparedness organisation and to have equipment calibrated and ready to use but they are not obliged to respond within a certain time. The laboratories are spread over Sweden and they are mainly situated at university institutions, but a few of them are situated in central authorities and one is at a private company. The laboratories have expertise and resources for gamma spectrometry, alpha spectrometry, liquid scintillation counting, whole body counting and retrospective dosimetry. For field monitoring there are six mobile radiation laboratories (three trucks and three carriers) placed among the ten laboratories. The trucks and the carriers have equipment for mobile gamma spectrometry, in situ gamma spectrometry and environmental sampling. Several different handheld instruments for dose rate monitoring, nuclide identification and gross alpha and beta counting are also part of the equipment. Through the Geological Survey of Sweden, one of the laboratories under contract with SSI, there is a very good resource for aerial surveys. With around three months of aerial surveys per year the team is very experienced. In addition to the system from the Geological Survey, three of the six mobile laboratories have equipment for aerial surveys. In case of an R/N-incident in Sweden, helicopters from the Swedish Police Service would be used for aerial surveys with these systems. An organisation for radiation measurements in agriculture, using voluntary defence organizations and the contract laboratories mentioned above, has been equipped and trained over the last couple of years and is now fully operational.

F.5.3 Regulatory control

SSI and SKI have inspected the on-site emergency preparedness both separately and together. Areas that have been assessed are documentation and implementation of plans and regulations. SSI have also inspected the capabilities of the licence-holders to ensure the radiation protection of their staff in accidents with high radiation levels, and procedures for alarming and to provide continued information about technical and radiation protection status.

In addition to inspections of the emergency planning, SKI and SSI have occasionally inspected the plant actions during emergency exercises. For this purpose a special inspection model has been developed in order to assess the most important tasks for safety. The counties' off-site emergency planning is reviewed by the Swedish Rescue Services Agency.

F.5.4 Conclusion

Sweden complies with the obligations of Article 25.

[20)] The monitoring and measuring duties previously assigned SSI has been transferred to the Swedish Radiation Safety Authority.

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 (1998:808) prior permission is needed for decommissioning and dismantling. As described in Section E.2.1.3 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 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 in which they are conducted;
- ensuring the safe handling and final disposal of nuclear waste arising in the activities or nuclear material arising therein that is not reused; and
- the safe decommissioning and the dismantling of plants in which nuclear activities are no longer to be conducted.

It follows from the third paragraph that a licence holder is not exempted from responsibilities according to the act until decommissioning and dismantling has taken place. The general regulations SKIFS 2004:1 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, the general regulations SKIFS 2004:1 and several SSI 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 the regulations on radiation protection that are applicable at nuclear facilities are also valid during decommissioning (see section F.4). One exception is the regulations SSI FS 2000:12 concerning protection of human health and the environment from discharges of radioactive substances from certain nuclear facilities. The regulations are under revision and it is possible that they will also be valid during decommissioning of nuclear facilities in the future.

Filing of documentation at nuclear facilities is regulated in SSI FS 1997:1. 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 SSI FS 2001:1. The register shall for example 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 SSI FS 2002:4. 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 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 SSI 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 SSI 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 regulatory authority assigned by the Government 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. SSI 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.

F.6.2 Measures taken by the license holders

The nuclear power companies are themselves responsible for planning, licensing and decommissioning of 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 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. A method for dry interim storage of core components has been developed, along with a database system for registration of waste.

The most important milestones during the coming three-year period are:

- A new safety analysis report (SAR) covering the operation of the final repository for radioactive waste (SFR 1), was submitted to the regulatory authorities in January 2008. The long-term safety analysis report will be submitted in April 2008.
- Design and modification of the existing BFA on the Simpevarp Peninsula for interim storage of core components.
- Licensing and manufacture of the ATB-1T waste transport container for intermediate-level long-lived waste. The supporting material for licensing will be ready in 2009. Manufacture will start one year later.
- Planning for an extension of SFR began during 2007. The extension should be ready for operation by 2020. Investigations of the bedrock will start during 2008.

The next six-year period also includes the following milestones:

- Start of operation of dry interim storage of long-lived waste from other power plants than Oskarshamn in BFA, no earlier than the end of 2011. OKG is already using BFA today for dry interim storage.
- Preparation of a preliminary safety analysis report (PSAR) and an environmental impact statement (EIS) for an application for a permit to extend SFR. According to the plans, the application will be submitted to the regulatory authorities in 2013.

The planning for the final repository for long-lived low- and intermediate waste (SFL) will begin after the application for a permit to extend SFR has been submitted. SFL is not expected to start operation before 2045.

Commercial power plants

So far only generic decommissioning plans have been developed for the Swedish nuclear power plants as part of the basis for the annual cost estimates (see section E.2.1.4) but the closure of the nuclear power reactors Barsebäck 1 and Barsebäck 2 has resulted in extensive planning work at the plant to prepare for the complete dismantling and decommissioning. All nuclear fuel has been removed from Barsebäck 1 and 2 and transported to Clab for interim storage. A detailed decommissioning plan for both units has been submitted to, and approved of, by the regulatory authorities. A revised version is underway and is planned to be submitted during 2008. According to current plans, large scale dismantling and demolishing work on the twin unit plant will begin not sooner than 2017.

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 licence-holders and submitted to SKI 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.

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 (RD&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.

Section G - Safety of Spent Fuel Management

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.

The Swedish Party complies with the obligations of Article 4.

The legislative and regulatory system in Sweden do not distinguish between general safety requirements for a facility for the management of spent nuclear fuel and the general safety requirements for a facility for the management of radioactive waste, as regards the objectives of the Joint Convention. Thus, in order not to duplicate information in this report, information regarding general safety requirements for a nuclear facility is presented in section H.1.

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.

Summary of developments since the last national report

- The extended part of the central interim storage for spent fuel (Clab) has been approved for operation

G.2.1 Regulatory requirements

The general safety regulations (SKIFS 2004:1) 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 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 can lead to a radiological accident.

Safety Report
A preliminary safety report shall be prepared before a facility may be constructed. A final safety report shall be prepared before the facility may be taken into operation. The contents of the safety report are specified in the regulations. Before the facility may be constructed and taken into operation, the safety report shall be evaluated and approved by the regulatory authority. The safety report shall subsequently be kept up-to-date.

In the updating of the general safety 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 control that the applicable safety related aspects of a specific issue have been taken into account and that appropriate safety-related requirements in SKIFS 2004:1 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 the parts of the organisation, that are responsible for the specific issues (”primary review”), as well as within a safety review function appointed for this purpose, that shall have an independent position relative to the parts of the organisation, that are 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 of safety measures, engineering as well as organisational, which arises 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 in every ten years, a new, integrated analysis and assessment of the safety of a facility shall be made. The analyses, assessments as well as the measures proposed on the basis of these shall be documented and submitted to the regulatory authority. When the regulation was updated 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 introduced, the regulatory authority shall be notified and the Inspectorate can decide that additional or other requirements or conditions shall apply with respect to the modifications.

G.2.2 Measures taken by the license holders

G.2.1.1 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, prevoiously contracted out to OKG, in January 2007. SKB has implemented the requirements in the general regulations SKIFS 2004:1 in its operating organisation. The organisational 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 licences. In the general regulations SKIFS 2004:1, 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. Although there was at the time no formal requirement to perform a periodic safety review, SKB decided, after consultation with SKI, to perform such a review. The main purpose was to gather experience from the construction and operation of the existing facility to be utilised in the design and construction of the extension. The so-called CLAB-ASAR 96 was submitted for review to SKI in 1997. In the report SKB identified 14 recommendations for improvement to the operation of Clab, and the regulatory review identified a few additional recommendations. The recommendations have been implemented for the most part.

The construction of the new storage pools (Clab 2) was completed during 2004. SKB submitted an application for a licence to take the pools in operation in December 2004, supported by an updated safety report. SKI requested amendments to the updated safety report and SKB submitted a new revision of the report in 2005.

In the beginning of 2006 SKB discovered problems with movement joints in a transport channel between the existing and the newly built storage pools. No storage was permitted in Clab 2 until the problem was solved. SKB developed a new technical solution for the movement joints and SKI approved this solution in April 2007. Rebuilding work of the transport channel was carried out and Clab 2 was taken in operation 2008-01-01 after approval of from SKI. SKI's decision includes the condition that SKB shall carry out the prepared inspection programme and that the results shall be documented and reported to the Inspectorate. The inspection programme includes monitoring of pool temperatures, pool movements and dose loads.

G.2.1.2 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 of the fuel are to be reprocessed and the recovered uranium and plutonium will be manufactured to MOX-fuel. The MOX-fuel shall be imported back to Sweden to be used in the Swedish nuclear power units in Oskarshamn. The corroded parts of the R1-fuel are still temporarily stored at the Studsvik site.

G.2.3 Regulatory control

At the time that the Joint Convention entered into force, the general safety status of the Swedish spent nuclear facilities was satisfactory.

For a few years after the introduction of general regulations concerning safety in certain nuclear facilities, review activities was focused on the implementation of the regulations. The regulations, revised as SKIFS 2004:1 and described in section E.2.2.4, provide a more structured approach to inspection and safety assessment, and have generally improved the situation. Extensive inspections of the safety review functions and fulfilment of the competence assurance requirement have been carried out.

Compliance with the requirements on competence assurance in the general safety regulations SKIFS 1998:1 was inspected in 2000 at all the nuclear power sites. These inspections showed a need for improved analysis tools, in order to define competence requirements, for other personnel groups than operating personnel, for whom a systematic approach has been used for several years. Work was initiated within the implementing organisations at all the sites to improve the analysis tools, and was in principle completed by the end of 2002.

The conclusions drawn by SKI from these inspections were that requirements on documentation of the new procedures were not fully met. There was some disagreement with the licensees about how to conduct the independent safety review in relation to the primary reviews. This issue has been addressed in joint discussions with the licensees. The safety programmes required of each licensee according to SKIFS 1998:1, revised as SKIFS 2004:1, have been requested by SKI and were submitted by all sites in 2000.

SKI has monitored the extension works at Clab closely. SKI approved the operation of the Clab2 in December 2007 and the extended parts of the facility was taken in operation in the beginning of January 2008. SKI's approval 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.2.4 Conclusion

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.

The Swedish Party complies with the obligations of Article 6.

The legislative and regulatory system in Sweden does not distinguish between the siting procedure for a facility for management of spent nuclear fuel and the siting procedure for a facility for management of radioactive waste, as regards the objectives of the Joint Convention. Thus, in order not to duplicate information in this report, information regarding the procedures for the siting of a nuclear facility is presented in section H.3.

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 SKIFS 2004:1, 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 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 4§ first paragraph in the Act on Nuclear Activities (1984:3). This is clarified further in the revised general safety regulations (SKIFS 2004:1) 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 final disposal of nuclear waste, or nuclear material that is not reused, as well as the safe decommissioning and the dismantling of facilities.

The general regulations concerning safety in certain nuclear facilities contains a special a chapter on decommissioning with requirements on 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 regulations on Planning before and during decommissioning of nuclear facilities (SSI FS 2002:4) comprises requirements for decommissioning with respect to documentation, alternative actions and waste management (see section E.2.1.2).

G.4.1.3 Technology supported by experience

The revised general safety regulations (SKIFS 2004:1) specify requirements regarding design and construction. It is stated that in order to meet the basic safety provisions 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 specified as follows:

- The design principles and design solutions shall be tested under conditions corresponding to those, which 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 the 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, which 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 SKIFS 2004:1.

G.4.2.2 Conceptual plans and provisions for decommissioning

Generic decommissioning plans have been developed by SKB, as part of the basis for the annual cost calculations (see section E.2.1.4). The final closure of Barsebäck 2 has caused the management of Bar-

sebäck to initiate a more detailed study on the decommissioning of the site. A detailed decommissioning plan for Barsebäck 1 and Barsebäck 2 has been submitted to, and approved of, by the regulatory authorities. A revised version is under way and is planned to be submitted during 2008.

G.4.2.3 Technology supported by experience

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. 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.

Design of the encapsulation plant is proceeding in steps. The ongoing design step corresponds to the level of detail required in an application for a permit to build a plant. The design of an encapsulation plant at Clab has previously been carried out to this stage. The ongoing design process is thus a revision where experience from the Canister Laboratory, changes in the regulatory framework and technical progress are being incorporated in the design.

The goal is to design the repository for spent nuclear fuel, with associated infrastructure and activities, so that the stipulated requirements are satisfied. The repository facility is described in general terms in facility descriptions. They show the layout and placement of the surface and underground parts and the coordination between them. An account is also given of the vehicles, machines, etc., that are needed in the facility, including technical systems and installations required for construction and operation.

Facility descriptions are important supporting documents for planning of the construction phase, reliability analysis, system analysis, safety assessment and environmental impact assessment (EIA). The facility descriptions will now be prepared since the site investigation programme in Forsmark and Laxemar have largely been concluded. The facility descriptions will serve as a basis for applications for permits for the spent nuclear fuel repository under the Environmental Code and the Nuclear Activities Act.

Preparation of main and engineering documents will begin during the application period and will then continue during the construction phase. There are no equivalent standards and regulations governing the design of the underground part's rock caverns. SKB has therefore issued a document called "Deep repository, Underground Design Premises". This document is revised continuously and describes the methodology for design and includes descriptions of and/or references to:

- the premises on which design is to be based, the design premises;
- how design is to be carried out;
- how the results of design are to be verified; and
- how the results of design are to be documented.

The methodologies for designing the two parts of the repository, the surface part and the underground part, are different. The surface part is more or less a conventional industrial facility and will comply with existing standards and regulations governing buildings and mechanical and electrical installations. The repository facility is also a nuclear installation, which will be taken into account in preparing the design-controlling documents for the technical systems and in designing, for example, the special access protection for the facility's underground part. The methodology for design of the underground part that has been used and refined in a pilot project will be applied in the design of the repository.

Both the Canister laboratory and the Äspö laboratory have been used for several years in developing technologies for encapsulation and disposal of spent fuel. This experience is and will be used, together with the possibilities for testing and analysis, when the encapsulation plant and the repository for spent nuclear fuel are designed and constructed.

G.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 revised general regulations (SKIFS 2004:1).

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).

Summary of developments since the last national report

- The regulatory authorities have jointly reviewed a preliminary safety assessment for a repository for spent fuel (SR-Can) as part of the ongoing consultations between SKB and the Swedish authorities.

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 (SKIFS 2004:1). 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, and a final safety report shall be prepared before the facility may be taken into operation. The safety reports shall contain information as specified in the regulations. The preliminary and the final safety reports shall be reviewed, evaluated and approved by SKI as required. The final safety report shall be kept up-to-date.

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.2.1.3. 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 Nuclear Activities Act (1984:3), and a building permit under the Planning and Building Act (1987:10). 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 repository 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 SKI'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 Nuclear Activities Act, 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
SKB RD&D-programme is focused on an application to site and construct a repository for spent nuclear fuel. The main goal of the long-term research activities conducted by SKB is to understand how different processes (long-term changes) may affect a repository's performance. The results from research activities are used in the safety case.

Preliminary long term safety analysis for a spent fuel repository (SR-Can)
During 2006, SKB presented a safety assessment report for a repository of a KBS-3 type (SR-Can) to the regulatory authorities. The main goal of SR-Can was to prove that encapsulation of canisters (sealing and testing) is possible to carry out with available and demonstrated technique, and that the canisters provide adequate barrier function in the repository, given the repository environment. Experimental data from the demonstration phase of the work therefore comprised an important part of the input data for SR-Can. A summary of the most important findings in the SR-Can project are listed below:

- No canisters are assessed to fail during the initial temperature period, expected to last severat thousands years
- A repository at Forsmark is assessed to comply with the regulatory risk criterion
- A repository at Laxemar is preliminary assessed to comply with the regulatory risk criterion- but more representative data is required
- Freezing of an intact buffer is assessed as ruled out- even for very pessimistically chosen climate conditions
- Canister failure due to isostatic load is assessed as ruled out- even for very pessimistically chosen climate conditions
- Oxygen penetration is preliminary assessed as ruled out- even for very pessimistically chosen conditions
- The risk contribution from earthquakes is assessed as small
- Loss of buffer may occur from exposure to glacial melt waters but the extent is uncertain- further studies are required
- Substantial loss of buffer may lead to canister failures in very long time perspectives
- A prolonged period of warm climate (increased greenhouse effect) before the next glacial period is assessed as primarily beneficial for repository safety
- Crucial to avoid deposition positions intersected by large or highly water conductive fracures- further studies are required
- The heat from the canister may fracture the rock in the deposition hole wall, which may enhance the in- and outward transport of dissolved substances- further studies are required
- The importance of the backfilled deposition tunnels as a transport path for radionuclides is limited
- The importance of the excavation damaged zone in the rock around the deposition tunnels as a transport path for radionuclides is limited

In March 2008 the regulatory authorities SKI and SSI presented their review on the SR-Can report (see G.5.3).

The SR-Can project is an important part of the preparatory work for the forthcoming safety assessment report (SR-Site), which will be used in support of SKB's application to site and construct a repository for spent nuclear fuel. The main goal with SR-Site is to prove that the total body of material available satisfies the regulatory requirements regarding long-term safety. The intention in SR-Site is to perform a safety assessment for two sites, to the equivalent level.

Measures taken and planning for consultations and 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, be in possession of 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 revised safety report (SAR) and operational limits and conditions (OLC) should also be submitted and approved by the regulatory body before starting commercial operation.

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 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 repository (SR-Can)
The Swedish regulators SKI and SSI have jointly reviewed the SKB safety assessment SR-Can. This review is considered as part of ongoing consultations between SKB and the Swedish authorities[22], 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 repository.

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 assessment methodology, the representation of the engineered barrier system in the safety assessment, and the handling of site specific information, respectively. Moreover, independent modelling 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 repository 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 repository.

G.5.4 Conclusion
Sweden complies with the obligations of Article 8.

[22] The Swedish Government decided in 2001 that consultations between SKB and the Swedish authorities (originally SKI and SSI, but now the new Swedish Radiation Safety Authority) should continue through the site investigation phase.

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 safety regulations (SKIFS 2004:1) contain legally binding requirements relevant for all obligations of Article 9. These requirements are summarised below.

G.6.1.1 Initial authorisation

As mentioned in section G.5, a preliminary comprehensive safety report (PSAR) is required before the construction of a spent nuclear facility. A update safety report (SAR), which also takes into account the results from commissioning tests, is required before the facility is taken into operation.

As mentioned in section G.5, a comprehensive safety analyses are required before a spent nuclear facility is constructed and taken into operation. These analyses shall subsequently be kept up to date. A preliminary safety report is required before construction, to show how the plant is built, analysed and verified and how the safety requirements are met. The safety report has to be renewed before commissioning tests and be finalised, taking into account the results from testing operation, before the plant may be taken into routine operation. (Chapter 4, §§ 1 and 2).

G.6.1.2 Operational limits and conditions

Documented up-to-date Operational Limits and Conditions (OLC) are required as further specified in a separate appendix to the regulations. The OLC's 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 (cf G.2.1) by the licensee and submitted to SKI for approval. The licensee shall notify SKI 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 revised general regulations SKIFS 2004:1 contain 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; and
- 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 SKIFS 2004:1, 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 SKI. 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 in this annex:

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 SKI. Regarding category 3 events, there is no requirement to make a specific report to SKI. 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. 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.

G.6.1.7 Decommissioning plans

In the revised general regulations SKIFS 2004:1 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; and
- 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 (SKIFS 2004:1) contain legally binding requirements relevant for all obligations of Article 9. These requirements are summarised 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, is the first time the modernised legislative and regulatory system has been implemented. After solving some technical problems (see G.2.2.1) the extension of Clab was taken in operation 2008-01-01 after approval of from SKI.

Although neither the Environmental Code, the SKI regulations 2004:1 and 2002:1, 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 process for the encapsulation plant, and the final repository for spent nuclear fuel , has already been initiated in accordance with the procedures outlined in this document. A preliminary time schedule for the required activities is presented in the introduction of this document. The procedure is described in detail in section H.3.

G.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 operation of the Swedish nuclear activities. Every OLC is facility-specific and is approved by SKI as part of the licensing conditions.

The original OLC for each facility is derived from the safety analyses in the SAR, in which the behaviour 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 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 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 is 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 fulfils 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

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.6.2.5 Incident reporting

Incidents significant to safety are reported according to the non-routine reporting requirements in the technical specifications (see section G.19.1.5). Two types of licensee event reports (LER) exist. The more severe one, called abnormal event, requires the facility to inform SKI, and in some cases also SSI, 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 SKI. 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 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 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 SSI.

G.6.2.6 Operating experience analysis and feed back

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.

G.6.2.7 Decommissioning plans

Conceptual decommissioning plans for Clab and the encapsulation plant has been prepared and is updated as needed. Two conceptual decommissioning plans (alternatives Forsmark and Oskarshamn) for the final

repository for spent fuel is under way and will be enclosed in the license application 2009. The conceptual 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.

G.6.3 Regulatory control

G.6.3.1 Initial authorisation

The regulatory control is achieved through the procedures described in sections E.2.2.1 (Licensing) and E.2.2.2 (Institutional control, regulatory inspection and reporting).

G.6.3.2 Operational limits and conditions

Applications for changes to OLC, and for exemptions from OLC, are reviewed by inspectors and specialists at SKI. 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 SKI inspected 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. SKI 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.

G.6.3.3 Procedures

Operational and maintenance procedures are normally not reviewed by SKI. Only in connection with event investigations would SKI ask for a procedure to be submitted for review. In the frame of quality assurance inspections or reviews of quality audits made by the licensees (see section F.3) have SKI reviewed into the routines used for updating procedures.

G.6.3.4 Engineering and technical support

SKI 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, LERs, 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 licensee. If there are any regulatory concerns the issue is brought up at a management meeting and a decision made about any further measures to be taken by SKI.

G.6.3.6 Experience feedback analysis

The major operating experience feedback comes from within the organisation itself and consequently the largest analysis effort is focused on the events in their own facility. The RO reports constitute an essential input into this analysis task, together with specific operating experience reports that are written for events not meeting the RO criteria, or so called near-events. MTO analysis is used, when root-causes and analysis in-depth are deemed necessary or desirable.

G.6.3.7 Decommissioning plans

Decommissioning plans (see section G.6.1.7) must be submitted to SKI for approval before 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 placed in final storage is defined as nuclear material; and
- spent nuclear fuel which has been placed in final storage 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 final 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.

Section H - Safety of Radioactive Waste Management

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, society and the environment are adequately protected against radiological 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 June 2007 the first cost calculations under the new Act (2006:647) on Financing of Management of Residual Products. The Government decided in December 2007 on the size of fees and guarantees for the nuclear power plant owners organisation.
- SKB submitted in September 2007 the eighth RD&D-program 2007. The regulatory authorities have evaluated the program and submitted a statement to the Government.

General

Swedish legislation makes a distinction between radioactive waste originating from nuclear activities (spent fuel and nuclear waste) and radioactive waste emanating from activities outside the nuclear fuel cycle, e.g. medical use, industry, research and consumer products, etc. (definitions of radioactive waste and nuclear waste according to Swedish law are given in section E.1). However, the legislative and regulatory systems do not distinguish between the general safety requirements for a facility for the management of radioactive waste and general safety requirements for a facility for the management of spent nuclear fuel, with regards to the objectives of the Joint Convention. Thus, in order not to duplicate information in this report, information regarding the general safety requirements of a nuclear facility described in this section are not repeated in section G.1.

H.1.1 Regulatory requirements

H.1.1.1 The general obligations of license-holders

As accounted for in section E.2.1.1, the Nuclear Activities Act (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 RD&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.2.1.4, the Financing Act (2006:647) requires the licensees to submit, every three years, estimates of all future costs for management and final 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 build up 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 SKIFS 2004:1. 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 SSI FS 2001:1. The regulations put requirements on waste management plans and registration of waste and reporting to the SSI. At the facility a register shall be kept over waste that without further treatment is to be transferred to final 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 SSI. 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 final 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 (SSI FS 1998:1). The purpose of these regulations is to limit the harmful effects on human health and the environment in connection with the final disposal of spent nuclear fuel and nuclear waste. Discharges to air and water from a facility to the surrounding environment are regulated in SSI FS 2000:12 (see section F.4.1.2).

In addition there are requirements concerning the long-term safety of a repository in the regulations SKIFS 2002:1. According to the regulations, the safety assessment for a repository should also comprise features, events and processes that can lead to the dispersion of radioactive substances after closure.

As presented in section E.2.1.2 regulations concerning clearance of nuclear and non-nuclear waste has been issued, SSI FS 1996:2 and SSI FS 1983:7, respectively.

Criticality and removal of residual heat

The revised general safety regulations (SKIFS 2004:1) 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.

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 both SKI's and SSI's regulations:

- An up-to-date inventory of all spent fuel and radioactive waste on-site (SKIFS 2004:1 and SSI FS 2002:1).
- 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 (SKIFS 2004:1).
- 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 SKI notified before any measures are taken. The documentation is subject to a twofold safety review by the licensee before notification (SKIFS 2004:1).
- 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 (SSI FS 2001:1).
- 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 (SSI FS 2000:12).
- 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 (SSI FS 1998:1).

Protection of individuals, society and the environment

General radiation protection provisions are described in section F.4.1.

SSI has particularly addressed radiation protection of the public and the environment in connection with radioactive waste management in three different regulations (SSI FS 1998:1, 2000:12 and 2001:1, see E.2.1.2). In summary it is required that:

- a repository 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.

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 both SSI and SKI have required 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 repository is addressed in SKIFS 2002:1.

Only packages approved by SKI and SSI have been allowed to be transported to a repository. For this approval, the waste must comply with the conditions stated in the safety report of the repository. 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 repository.

Strive to avoid actions that impose impacts on future generations
One purpose of SSI FS 2001:1 is to limit the harmful effects of radiation from the waste today and in the future. In SSI FS 2000:12 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. SSI FS 1998:1 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.

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 for 2008 and 2009
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 licence for the operation of nuclear power reactors, on an annual basis.

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.

The final report from the Committee was submitted to the Government in December 2004. As a result of the review, the previous legislation was replaced by the Act (2006:647) and the Ordinance (2008:715) on Financing of Management of Residual Products from Nuclear Activities.

SKB submitted in June 2007 the first cost calculations under the new Act (2006:647) on Financing of Management of Residual Products.

Evaluation of the RD&D Programme 2007
The nuclear industry, through its co-owned company SKB, has performed research on the final storage 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. SKB plans to submit a licence application for siting and construction of the final repository in 2010.

Since 1986 SKB has produced eight R&D programmes with KBS-3 as the main alternative for the disposal of spent fuel. SKB submitted in September 2007 the eighth RD&D-program to the Government. The table of contents for the RD&D Program 2007[23] is presented in appendix A.

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 G.2-7 and H.2-7, respectively.

H.1.3 Regulatory control

H.1.3.1 The general obligations of license-holders
Nuclear waste fees and guarantees for 2008 and 2009
SKI reviewed the cost calculations and submitted a statement with suggestion for the size of fees and guarantees to the Government in October, 2007. The Government decided in December 2007 on the size of fees and guarantees for 2008 and 2009.

Evaluation of the RD&D Programme 2007
SKB submitted in September 2007 the eighth RD&D-program 2007. The regulatory authorities have evaluated the program and submitted a statement to the Government.

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 G.2-7 and H.2-7, respectively.

H.1.4 Conclusion
Sweden complies with the obligations of Article 11.

[23] The program can be downloaded from SKB:s web-page: *www.skb.se*

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

The general safety regulations SKIFS 2004:1, 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. A final safety report shall be prepared before the facility may be taken into operation. 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 SKI. 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 SKIFS 2004:1 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 SKI. In the updating of the 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, SKI shall be notified and the Inspectorate can decide that additional or other requirements or conditions shall apply with respect to the modifications.

H.2.1.2 Past practices
As described in the introduction, section A.7.2, 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 0.0015 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.2.2.1 Existing facilities
Waste management at Nuclear Power Units
The contents of the safety reports at the nuclear power units were revised in 2001 and more details about the origin and treatment of waste was be included, especially with regards to traceability and documentation.

Final Repository for Operational Waste (SFR)
SFR, located at the FKA site, is a central final repository for operational waste from the nuclear power plants and for low an intermediate waste from Studsvik. The licensee for SFR, SKB, has made an agreement with FKA for the operation of the facility. FKA has implemented the requirements of the general regulations SKIFS 2004:1 in the operating organisation. SFR benefits from this since the management system for the operation of SFR is fully integrated with the management system for the operation of the nuclear power plants at the FKA site. SKB, as the licencee for SFR, is ultimately responsible for the implementation of the new regulations.

SFR has been in operation since 1988. A comprehensive monitoring and control programme has been in operation since the beginning of the construction work and will continue throughout the operating period. Groundwater flows, water chemistry, rock movement, the performance of the bentonite barrier and the properties of the waste are all monitored. Furthermore, a programme for continuous monitoring of the environment is being conducted. The information from these control and monitoring programmes provides valuable data for safety assessments.

The licence conditions include a requirement for an update of the Safety Report (SAR) at least every 10 years. Prior to the introduction of the general regulations SKIFS 1998:1 (revised as SKIFS 2004:1), the requirement for a periodic safety review (previously called ASAR: As Operated Safety Analysis Report) was only a condition in the NPP licences. In the general regulations the requirement for a periodic safety review is mandatory for all nuclear facilities. In June 2001, SKB submitted an integrated revised safety report and periodic safety review report for SFR called SAFE (see also H.5.2). In the regulators review, finalised in December 2003, of the SAR (SAFE 2001) the regulators required complementary information, e.g. on methods to determine the nuclide inventory in the repository. SKB submitted an updated SAR on the part covering operation of the repository in January 2008, and will submit the long-term safety analysis report in April 2008.

Early in 2007 SKB presented research results on methods to determine so called ”hard-to-measure” nuclides, i.e. C-14, Ni-59/63, Tc-99 and I-129, which indicated that the amount of some of these nuclides exceeded the operating license for parts of SFR or SFR as a whole. Based on these results, one of the regulators (SSI) in June 2007 closed SFR. To start the operation SKB had to apply for an updated operating license and further complement the information about the nuclide inventory in SFR. Based on SKB`s updated analyses, SSI re-opened SFR in March 2008 for all waste categories, except waste containing the highest amount of C-14 until further analyses has confirmed the C-14 inventory in the waste.

Temporary storage facilities at the NNP sites
Temporary storage for radioactive waste at the nuclear power plants, as described in section D.1.3, is in practice considered to be an integral part of the plant. The operation of the temporary storage facilities is therefore integrated with the operation of the nuclear power plants. Fulfilment of the requirements in the general regulation is thereby accomplished and verified through regulatory review and inspection activities at the nuclear power plants.

Temporary storage facilities at the Studsvik site
Temporary storage facilities for radioactive waste at Studsvik as listed in section D.1.4.2, have individual licences. Following the issuance of the SKI general regulations SKIFS 1998:1 (revised as SKIFS 2004:1) revised safety reports and safety programmes have been submitted to, and approved by, SKI.

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. AB SVAFO was acquired by Studsvik AB in 2003.

According to estimates, SEK 1.8 billion 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 SKI.

H.2.3 Regulatory control
At the time that the convention entered into force, the general safety status of the Swedish spent nuclear facilities was satisfactory. As accounted for in the first report under the Convention, SKI has developed its inspection practice as a result of the general safety regulations SKIFS 2004:1. These regulations, described in section E.2.2.4, provide a more structured approach to inspection and safety assessment and have generally improved the situation. Extensive inspections of the safety review function and fulfilment of the competence assurance requirement have been carried out.

Compliance with the requirements in the general safety regulations SKIFS 1998:1 concerning the assurance of competence was inspected in 2000 at all the nuclear power sites. These inspections showed a need for improved analysis tools, in order to define competence requirements, for other personnel groups than operating personnel for whom a systematic approach has been used for several years. Work was initiated within the implementing organisations at all the sites to improve the analysis tools, and was in principle completed by the end of 2002.

The conclusions of SKI from these inspections were that requirements concerning documentation of the new procedures were not fully met. There was also some disagreement with the licensees about how to conduct the independent safety review in relation to the primary reviews. This issue has been addressed in joint discussions with the licensees. The safety programmes required by each licensee according to SKIFS 1998:1 have been requested by SKI and were submitted by all sites in 2000 for review.

No formal requirements for the management of spent fuel and radioactive waste were established in Sweden until the late 1970's.

As described in section A.5.1 in the introduction, the authorities performed a joint study during the mid 1990's with the objective of improving the understanding of past practices regarding the management of radioactive waste. The report concludes that there is no indication of any waste containing plutonium or radium not being under satisfactory supervision. Another important conclusion in the report is the importance of keeping proper records.

H.2.4 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.

The legislative and regulatory system in Sweden does not distinguish between the siting procedure for a facility for the management of radioactive waste and the siting procedure for a facility for the management of spent nuclear fuel, with regard to the objectives of the Joint Convention. Thus, the information presented in this section is valid for all nuclear facilities, including the siting of the proposed facility for management of spent nuclear fuel. In order not to duplicate information in this report, information regarding the procedures for the siting of a nuclear facility in this section is not repeated in section G.3.

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.2.1.3). The licensing procedure is described in section E.2.2.1.

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 (SKIFS 2004:1), 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 repository 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.2.1.1 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 emphasises 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 SKI, SSI 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 repository, 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, for the period of 1 January 2005-31 December 2008.

The decisions concerning reimbursement to municipalities and non-profit organisations have been made by SKI[24] (see also E.2.1.4).

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 R&D-programme is also run by SKB. The following activities are currently carried out by SKB:

- The R&D-programme has been reported every third year since 1986. The most recent R&D report was submitted in 2007.
- Consultations and an EIA for the planned encapsulation facility and the repository for spent nuclear fuel began formally in 2002, but in practice started in the mid-1990's.

[24] As from July 1, 2008, decisions on reimbursements to concerning reimbursement to municipalities and non-profit organisations will be made by the Swedish Radiation Safety Authority.

H.3.2.2 Consultations and environmental impact statement

Early consultations have been carried out for both the encapsulation plant and the repository 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. Consultations are coordinated for the encapsulation plant and repository for spent nuclear fuel. The consultations relates 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 have initially mainly dealt with the scope of EIA. Preliminary scoping reports have been prepared as a basis for discussion. Viewpoints and proposals that emerge during the consultations are 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 is presented at the consultation meetings, and the participants are given an opportunity to state their views. This phase will continue for as long as investigations, facility design work and studies are pursued.

When the necessary investigations have been completed, a preliminary EIS will be compiled. Before the application is submitted, SKB intends to verify major conclusions with the concerned consultation parties. A summary report from the consultations will be submitted together with license applications to site and construct the encapsulation plant and the repository for spent nuclear fuel, respectively.

In addition to the formal consultations, extensive information activities are aimed at municipalities, organizations and the public. These activities will continue to be pursued in parallel with the statutory consultation meetings.

The last facility that will be built in the LILW programme is the final repository 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

SKI reviews SKB's R&D programme and circulates it for comments to SSI and 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 SKI's recommendations are sent to the Government for its decision.

SKI and SSI have regular consultations with SKB regarding progress in the siting of the planned facilities.

SKI and SSI are 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 (SKIFS 2004:1) 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 (SKIFS 2004:1) 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 activities is responsible for ensuring that all necessary measures are taken to ensure the safe handling and final 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 (SKIFS 2004:1) 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 facility.

The regulations on planning before and during decommissioning of nuclear facilities (SSI FS 2002:4) 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 (SKIFS 2004:1) 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 he disposal of nuclear material and nuclear waste (SKIFS 2002:1) 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 repository construction, repository operation and repository closure.

H.4.1.4 Technology supported by experience

The general regulations concerning safety in nuclear installations (SKIFS 2004:1) 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 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 concerning safety in nuclear installations (SKIFS 2004:1).

H.4.2.2 Conceptual plans and provisions for decommissioning

Generic decommissioning plans have been developed by SKB, as part of the basis for the annual cost calculations (see section E.2.1.4).

H.4.2.3 Technology provisions for closure of repositories

Technical provisions for the closure of the final repository 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 modernisation 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 (SKIFS 2004:1).

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 (SKIFS 2004:1). 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, and a final safety report shall be prepared before the facility may be taken into operation. The safety reports shall contain information as specified in the regulations. The preliminary and the final safety reports shall be reviewed, evaluated and approved by the regulatory authority as required. The final safety report shall be kept up-to-date.

Additional requirements concerning the long-term safety of a repository are stipulated in the regulations concerning safety in connection with he disposal of nuclear material and nuclear waste (SKIFS 2002:1). According to the regulations, the safety assessment for a repository 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 repository construction, before repository operation and before repository 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.2.1.3.

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 Nuclear Activities Act (1984:3), and a building permit under the Planning and Building Act (1987:10). 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 repository 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 SKI's[25] 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 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 repository 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.

The goals of the planned activities for the period 2008-2013 are as follows:

- Continue the studies of diffusion and sorption of radionuclides in high-pH concrete and rock. An important aspect is the influence of organic compounds on radionuclide sorption at high pHs, in particular isosaccharinic acid and cement additives.
- Develop the models for concrete degradation, including the effects of saline water.
- Continue the planning, which commenced in 2007, for the extension of SFR. The stage 1 extension is estimated to be put into operation in 2020. In connection with the first extension, the entire SFR, i.e SFR-1 and SFR-3 (the original name for the planned repository for decomissioning waste), will be licensed for deposition of both operational and decomissioning waste. The final repository will be subsequently only be called SFR.
- Site investigations will be commenced in 2008
- Prepare a preliminary safety analysis report (PSAR) and an environmental impact statement (EIS) for an application for a permit to extend SFR. According to the plans, the application will be submitted to the regulatory authorities in 2013. Continue the studies of diffusion and sorption of radionuclides in high-pH concrete and rock. An important aspect is the influence of organic compounds on radionuclide sorption at high pHs, in particular isosaccharinic acid and cement additives.
- Develop the models for concrete degradation, including the effects of saline water.
- Study the reactions between leachate from concrete and the surrounding gravel in the repository.
- Field studies and investigations of natural analogues of alkaline concrete environments.
- Studies of corrosion of metals in a concrete environment

[25] As from July 1, 2008, the matter will be prepared by the Swedish Radiation Safety Authority.

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 final safety report (SAR) and operational limits and conditions (OLC) should also be submitted and approved by the regulatory body before operation commences.

For a repository, 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 repository construction, and before repository operation and before repository 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 Artikel 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 (SKIFS 2004:1) 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[26]

All waste to be disposed of in SFR-1, 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-1 (SKB). The completed WTD is submitted to SKI and SSI for approval. SKI and SSI then jointly review the WTD and may issue specific conditions for the disposal of particular waste type. To ensure consistent and comparable WTDs SKI and SSI have issued guidelines 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 SSI[27] 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 (SKIFS 2004:1) 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 SKIFS 2004:1, 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 SKI[28]. 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 SKI. Regarding category 3 events, there is no requirement to make a specific report to SKI. It is sufficient to make a compilation of these events in the annual report.

[26, 27, 28] SKI and SSI was merged into a new regulatory authority, the Swedish Radiation Safety Authority, July 1, 2008. The new authority has been tasked with the responsibilities and tasks from the former Swedish Nuclear Power Inspectorate and the Swedish Radiation Protection Authority.

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 (SKIFS 2004:1). 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 SKIFS 2004:1 it is the responsibility of the licensee, as long as the repository is in operation, to continuously keep informed of the conditions of importance to the assessment of repository safety, also after closure.

H.6.1.8 Decommissioning plans

The general regulations concerning safety in nuclear installations (SKIFS 2004:1) 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 repository

The general regulations concerning safety in nuclear installations (SKIFS 2004:1) states that a facility for the final disposal of nuclear waste shall be designed so that the barriers can provide the required safety without monitoring or maintenance after the repository is closed. The regulations concerning safety in connection with the disposal of nuclear material and nuclear waste (SKI FS 2002:1) specify that the safety assessments for a repository 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 repository construction, before repository operation and before repository closure.

The safety assessment for a repository 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 repository is in operation, to continuously keep them selves informed of conditions of importance to the assessment of repository 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 repository for radioactive operational waste (SFR-1) was licensed for operation. As described in the introduction, two additional facilities need to be constructed and taken into operation: a repository for short-lived low and intermediate level decommissioning waste, and a repository for the disposal of long-lived low and intermediate level waste.

The general regulations concerning safety in nuclear installations (SKIFS 2004:1) 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 repository for short-lived low and intermediate level decommissioning waste in 2013, and operation is planned to commence in 2020. The repository is planned to be co-sited with the existing repository 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 repository 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, core-components 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 no earlier than the end of 2011 in BFA at the Simpevarp peninsula. OKG is already using BFA today 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 SKI[29] 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 fulfils 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 SKI[30], and in some cases also SSI[31], 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 SKI. Only a very limited number of events of this category

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[29, 30, 31] SKI and SSI was merged into a new regulatory authority, the Swedish Radiation Safety Authority, July 1, 2008. The new authority has been tasked with the responsibilities and tasks from the former Swedish Nuclear Power Inspectorate and the Swedish Radiation Protection Authority.

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 SSI.

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 (SKIFS 2004:1) 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 final disposal of spent fuel and radioactive waste (see section H.4.2.2).

H.6.2.9 Plans for closure of repository

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.2.2.1 (Licensing) and E.2.2.3 (Institutional control, regulatory inspection and reporting).

H.6.3.2 Operational limits and conditions

SKI 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 SKI inspected 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. SKI 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 SKI. Only in connection with event investigations would SKI 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 SKI looked into the routines used for updating procedures.

H.6.3.4 Engineering and technical support

SKI 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-1 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 SKI.

H.6.3.7 Experience feedback analysis

The regulatory control is achieved through the procedures described in section E.2.2.3 (Institutional control, regulatory inspection and reporting). SKI and SSI have 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 SKI[32] for approval before the decommissioning and dismantling activities may be started.

H.6.3.9 Plans for closure of repository

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.

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[32] SKI and SSI was merged into a new regulatory authority, the Swedish Radiation Safety Authority, July 1, 2008. The new authority has been tasked with the responsibilities and tasks from the former Swedish Nuclear Power Inspectorate and the Swedish Radiation Protection Authority.

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 (SSI FS 1997:1) 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 authorities' 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 repository 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 (SKIFS 2004:1) 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 repository is closed. This is further specified in the regulations concerning safety in connection with the disposal of nuclear material and nuclear waste (SKI FS 2002:1) in which it is stipulated that safety after closure of a repository 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 (SSI FS 1998:1) require that the long-term performance of a repository should not rely on any active measures.

All waste repositories so far taken into operation in Sweden - SFR-1 for low and intermediate level waste (Forsmark) and 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-1, 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, SSI has requested institutional control for a period of up to 50 years after closure of the repository. It is for the owner and operator of the repository 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 (SSI FS 2000:12), 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 (SKIFS 2004:1, 2002:1) stipulate that a facility for the final disposal of nuclear waste shall be designed so that safety after closure of a repository is provided by a system of passive barriers. Prior to the repository closure, the final safety assessment must be renewed and approved by the regulatory authority. If the regulatory authority approves the closure of the repository 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.

Section I - Transboundary Movement

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 provisions 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 movement 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 international 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 regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;
   (iv) a Contracting Party which is a State of origin shall authorize 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 transboundary 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 maritime, 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.

Summary of developments since the last national report

- The Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel, is implemented into the Swedish legislative and regulatory framework.

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 1334/2000; 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 supervision and control of shipments of radioactive waste and spent fuel, into the national legislation. The amended legislation, the Radiation Protection Act and the Nuclear Activities Act, will enter into force at the 25th of December 2008. Also, the current Regulations on Control of Imports and Exports of Radioactive Waste (SSI FS 1995:4) will be replaced with new Regulations on Control of Shipments of Radioactive Waste and Spent Fuel.

In summary, 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 radioactive waste safely.

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.

Section J - Disused Sealed Sources

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 reentry 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.

Summary of developments since the last national report

- New legislation in place
  - The Ordinance on Producer's Responsibility for Electrical and Electronic Equipment (SFS 2005:209)
  - The Ordinance on Producer's Responsibility for Certain Radioactive Products and Orphan Sources (SFS 2007:193)
  - The Regulations on the Control of High Activity Sealed Sources, (SSI FS 2006:2)
- A special funding arrangement has been established to cover the costs for the management and final disposal of non-nuclear legacy waste and orphan sources

J.1.1 Regulatory requirement

All handling of disused sealed sources (possession, remanufacturing, disposal) is covered by the Radiation Protection Act (SFS 1988:220). However, remanufacturing of disused sealed sources does not take place in Sweden. 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. Under 2005 and 2007 two new ordinances were issued in order to establish producer's responsibility for disused sealed sources; the Ordinance on Producer's Responsibility for Electrical and Electronic Equipment (SFS 2005:209) and the Ordinance on Producer's Responsibility for Certain Radioactive Products and Orphan Sources (SFS 2007:193). This means that the holder of the license could fulfil his primary responsibility to the safe handling and, if necessary, disposal of the disused source by handing it over to the responsible producer. If the holder of the license chooses not to use the option of producer's responsibility, the responsibility for the waste stays with him. According to the Radiation Protection Act (SFS 1988:220) the responsibility includes financial security or any other equivalent means for the safe management of disused sealed sources.

Detailed requirements on the handling of disused sealed sources are found in the following regulations.

- Regulations on the Control of High Activity Sealed Sources, (SSI FS 2006:2) 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 SSI.
- Regulations on Radiation Therapy (SSI FS 2000:4) 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 (SSI FS 2000:9) stipulate that the licence-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, should the question of decommissioning arise.
- Regulations on the Use of Equipment in Industry Containing Sealed Sources or X-Ray Tubes (SSI FS 1995:2) stipulate that equipment containing a radioactive source that will not be used anymore, shall be sent to a radioactive waste management facility within six months.

Sweden allows the re-entry of disused sealed sources into its territory for return to Studsvik Nuclear AB. Studsvik Nuclear AB has a licence from the Government for irradiation and from SSI to manufacture sealed sources and receive and possess disused sealed sources.

J.1.2 Regulatory control

Disused sealed sources are either returned to the supplier or manufacturer, or sent to Studsvik Nuclear AB. Studsvik is the only approved radioactive waste management facility in Sweden for handling radiation sources that need a licence. However, Studsvik Nuclear AB 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.

In 2003 a Governmental committee proposed a system with producer responsibility covering all products that utilize radioactive substances. The committee also suggested that the producer responsibility should also include historic waste, like orphan radiation sources. In response to these proposals the Ordinance on Producer's Responsibility for Certain Radioactive Products and Orphan Sources (SFS 2007:193) came into force in 2007.

The EC directive on High Activity Sealed Sources, 2003/122/Euratom, is incorporated into laws, regulations and administrative provisions before the 31 of December 2005. One important aspect has been to establish requirements on holders of high activity sealed sources to secure financial guarantees.

The EC Directive on Waste from Electrical and Electronic Equipment, 2002/96/EC, entered into force August 13, 2005 and comprises e.g. smoke detectors. Ionising smoke detectors may be of low activity compared to other sealed sources but they have been imported into Sweden in quite large quantities for several years, thus comprising a possible radiation protection problem when discarded units are to be handled. The SSI Regulations on Smoke Detectors for Domestic Use Containing Radioactive Sources (SSI FS 1992:4) were amended in 2003 to harmonize with the EC Directive.

SSI has since 2006 received special funding corresponding to EUR 100 000 per year from the Government, to cover the costs for the management and final disposal of non-nuclear waste from past practices, e.g. old radium and thorium products possessed by private persons and orphan sources.

J.1.3 Conclusion

The Swedish Party complies with the obligations of Article 28. There is however ongoing work to improve administrative matters concerning the handling and final storage of disused sealed sources in a manner that is satisfactory from a radiation protection point of view.

Section K - Planned Activities to Improve safety

K.1 License application for an encapsulation plant

SKB submitted a license application under the Nuclear Activities Act for an encapsulation plant in November 2006. SKB at the same time announced that extensive supplements were planned to be submitted in the end of 2008. A license application under the Environmental Code is planned to be submitted together with a license application under the Code for a repository for spent nuclear fuel (see section K.2 below). The regulatory review of the application will be co-ordinated with the review of a license application for a repository for spent nuclear fuel under the Nuclear Activities Act and the Environmental Code. (The licensing procedure is presented in section E.2.2.1.)

K.2 License application for a repository for spent nuclear fuel

The site investigations have been finalised and work is now focussing on the preparatory work to analyse data and to compile the license application documents. Consultations according to the Environmental Code are in the final stages. SKB plans to submit a license application for a repository for spent nuclear fuel under the Nuclear Activities Act mid 2010. SKB plans, at the same time, to submit a licence application under the Environmental Code for both the Encapsulation Plant and the repository for spent fuel. (The licensing procedure is presented in section E.2.2.1).

K.3 License application for a repository for decommissioning waste

SKB has initated the consultation process to site a repository for short-lived low and intermediate level decommissioning waste. The plan is to submit an application in 2010 and to have the repository in operation in 2020.

K.4 Development of waste acceptance criteria for long-lived waste

Final 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.

RD&D Programme 2007

Programme for research, development and demonstration of methods for the management and disposal of nuclear waste

September 2007

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Departementsserien 2008

Systematisk förteckning

Justitiedepartementet

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Europeiskt betalningsföreläggande. [2]

Ändringar i EG:s redovisningsdirektiv. [5]

Sveriges antagande av rambeslut om kampen mot organiserad brottslighet. [6]

Sveriges antagande av rambeslut om en europeisk bevisinhämtningsorder. [9]

Europeiskt småmålsförfarande. [12]

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Antagande av rambeslut om skydd av personuppgifter som behandlas inom ramen för polissamarbete och straffrättsligt samarbete. [30]

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