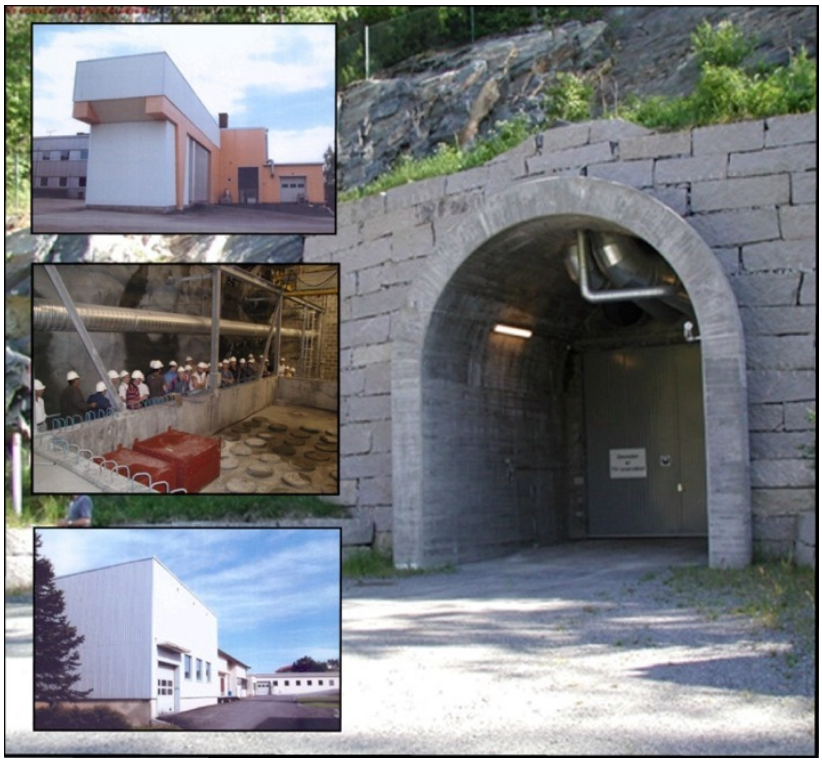
Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management



National Report from Norway

Second review meeting, 16 – 25 May 2006

Norwegian Radiation Protection Authority
Postbox 55, No-1332 Østerås, Norway

Statens strålevern
Norwegian Radiation Protection Authority

List of Abbreviations

HBWR	Heavy Water Boiling Reactor
IAEA	International Atomic Energy Agency
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
IFE	Institute for Energy Technology
JEEP	Joint Establishment Experimental Pile
KLDRA	Combined Storage and Repository for Radioactive Waste
LILW-LL	Low and Intermediate Level Waste – Long Lived
LILW-SL	Low and Intermediate Level Waste – Short Lived
LLW	Low Level Waste
MBA	Material Balance Areas
MOH	Ministry of Health and Social Care
MTI	Ministry of Trade and Industry
MTO	Man, Technology and Organisation
NORA	Norwegian 0 (zero) - power Reactor Assembly
NOU	Official Norwegian Report
NRPA	Norwegian Radiation Protection Authority
OECD	Organisation for Economic Co-operation and Development
TE-NORM	Technologically Enhanced –Naturally Occurring Radioactive Material
WATRP	Waste Management Assessment and Technical Review Programme

List of Content

Section A. Introduction

This report is the Norwegian report to the second review meeting to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) to be held at IAEA in Vienna, 15–26 May 2006. Norway signed the Joint Convention on 29 September 1997, the day it was opened for signature. The Joint Convention was ratified and deposited on 12 January 1998.

The report has been written in accordance with the guidelines concerning the form and structure of national reports, as established by the Contracting Parties under Article 29 of the Convention at the Preparatory Meeting held at IAEA, 10–12 December 2001. The report was prepared by the regulatory authority, the Norwegian Radiation Protection Authority (NRPA) assisted by the sole operator organisation in Norway, the Institute for Energy Technology (IFE).

The guidelines set out in the IAEA working document "Use of safety standards in relation to the Joint Convention" of March 2005 have proven useful for the writing of the report. References to the use of the IAEA Safety Standards in Norway have been supplied where appropriate.

The comments, questions and remarks given to Norway's initial national report and Norway's presentation given at the first review meeting have been incorporated in this report. The second report is a full revision of the first report.

This report concludes that Norway meets the obligations of the Joint Convention. However, Norwegian authorities will aim for development in the waste management policy and Norway will continue to improve its existing systems to further enhance safety, in line with the aims of the Joint Convention.

Section B. Policies and Practices

Article 32. Reporting (1)

Norwegian nuclear activities started in 1948 with the establishment of Institute for Atomic Energy, later renamed the Institute for Energy Technology (IFE), at Kjeller east of Oslo. In July 1951, the first research reactor, JEEP I, reached criticality, followed by the Halden Boiling Heavy Water Reactor in Halden (HBWR) in 1959. The NORA reactor, built at Kjeller in 1961, was shut down in 1968 and later decommissioned; likewise for JEEP I in 1967. JEEP II was built in 1965–66 and reached criticality in December 1966. At present, the JEEP II at Kjeller and the HBWR in Halden, southeast of Oslo, are in operation. JEEP II has a thermal capacity of 2 MW. HBWR has a thermal capacity of 25 MW, but is usually operated at less than 20 MW. Both reactors are owned and operated by IFE. A radioactive waste management facility started operation in 1948 at Kjeller and the Combined Disposal and Storage Facility for low and intermediate level waste in Himdalen, approximately 26 kilometres south-east of the Kjeller site has been in operation since 1999.

The management of spent nuclear fuel in Norway has gone through various phases. The first core loading in HBWR was stored after its discharge in 1961. In the 1960s, reprocessing was an emerging technology, and spent fuel from JEEP I was used as loading material in a pilot reprocessing plant at the Kjeller site. This plant was in operation from 1961 to 1968, then later decommissioned. However, reprocessing was still considered a viable option for the forthcoming Norwegian fuel cycle, the second core loading in HBWR was reprocessed in Belgium in 1969. The uranium and plutonium gained from the reprocessing was sold for civilian use, and the waste was disposed of in Belgium. When the third core loading was discharged, reprocessing was no longer a politically viable option; consequently, this and later discharged spent fuel from the HBWR are stored on site, together with the discharged first core loading. The remainder of the spent fuel from the JEEP I reactor, along with spent fuel from the NORA and JEEP II reactors, are being stored at Kjeller. Radioactive waste from the pilot plant is today disposed of at the combined disposal and storage facility in Himdalen. The remaining quantities of low-level liquid uranium solution will be solidified. Further details are given in section H of this report.

Existing spent fuel will, as far as possible considering its suitability for later direct disposal, be stored until final disposal is possible. The process of establishing a new long-term storage facility for spent fuel and long-lived waste has been underway for several years, however, the process is likely to gain further momentum in 2006, as discussed in section G.

Low- and intermediate-level waste, LILW, (mainly short-lived) has been conditioned and stored at Kjeller since the start in 1948. LILW from the HBWR was routinely transported to Kjeller for treatment. However, with an emerging shortage of storage capacity in the purpose-built buildings at IFE, it became necessary to initiate a process that could yield a permanent solution. A process for a disposal solution for the Norwegian LILW started in 1989. This process resulted in the establishment of the Combined Disposal and Storage Facility for LILW in Himdalen, approximately 26 kilometres south-east of the Kjeller site. The Himdalen facility, taken into service in 1999, consists of four rock caverns with two concrete sarcophaguses in each cavern. The Parliament decided that the facility should contain

a storage part where drums containing some plutonium should be stored. The final decision on these drums was deferred in order to ease public acceptance of the siting of the facility. The storage part of the facility has the same design as the disposal part, and is situated in one of the sarcophaguses in cavern No. 1. Everything – even waste packages – placed in the storage part must be in a disposal-ready form. After the final decision regarding disposal or not with respect to the storage part, the waste packages will either be removed or encased in concrete where they stand.

In 1970, approximately 1,000 drums of LILW were disposed of at the IFE site at Kjeller. The drums were buried in a 4-metre deep trench, which was then covered with clay. When it was decided to build a new disposal facility for LILW, it was also decided to retrieve the waste from the Kjeller site and move it to the new facility. IFE developed the plans and technical solutions for the retrieval process. This waste was excavated and reconditioned in 2002. To day it is disposed of or stored together with the rest of the waste at the Himdalen facility. During the process of retrieving the waste drums, all soil was checked for contamination. Only a small fraction was found to be contaminated. This soil was placed in an ordinary waste drum and stabilized by mixing with concrete. The rest of the soil was filled back into the trenches. Out of the retrieved waste, 166 drums (containing some amount of plutonium) have been placed in the storage part of the Himdalen facility.

All the LILW previously treated, conditioned and stored at IFE has now been moved to Himdalen. The current policy is to dispose of all the LILW (except TE-NORM, high activity disused sealed sources and larger amounts of long-lived waste) at the Himdalen facility. This facility is estimated to have sufficient capacity to accommodate disposal needs until 2030, including the waste from future decommissioning of IFE facilities. At that time, a decision will be made whether or not to convert the storage part into a repository.

General exemption levels do not currently apply. Decisions are made on a case-by-case basis, in line with the guidance given in the IAEA Safety Standard Series RS-G-1.7 (2004).

The Norwegian authorities are at present considering the future spent fuel and waste management policy. Important aspects are future needs for new nuclear facilities (i.e storage and disposal capacities), optimal use of existing and new facilities, organisational structure, financing and public confidence.

TE-NORM is not reported by Norway under the present Joint Convention. TE-NORM is not handled within the waste treatment system described in this report. However, the amount of TE-NORM from the offshore oil industry is considerable. This far, it has been stored onshore at the operation bases of the oil companies responsible for the oil production installations. At least two sites for final disposal of the TE-NORM are currently under consideration.

Section C. Scope of Application

Article 3. Scope of application

As a Contracting Party to the Joint Convention, Norway has:

(1) not declared reprocessing as part of Norwegian management of spent fuel;

(2) not declared waste that contains only naturally occurring radioactive materials as waste for the purpose of this Convention;[1]

(3) not declared spent fuel or radioactive waste generated within military or defence programmes as spent fuel or radioactive waste for the purpose of this Convention.

[1] The oil industry generates TE-NORM, which is at present time temporarily stored at the premises of the oil companies (see Section B). Decommissioning of platforms and equipment used in oil drilling will also generate TE-NORM waste. Norway has chosen, for this report, not to declare this type of waste as part of the reporting for the Joint Convention; however, any questions are welcomed and will be answered.

Section D. Inventories and Lists

Article 32 Reporting (2)

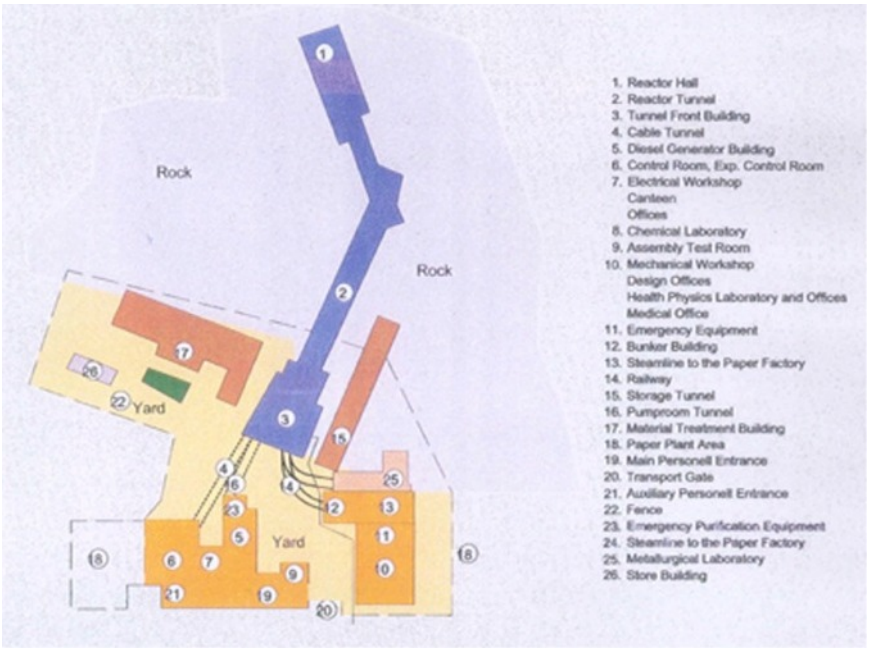
(i) Management facilities for spent nuclear fuel

There are three sites with nuclear facilities in Norway, as seen at the map in section E, all operated by IFE.[2] At the Halden site, the spent fuel is stored in a bunker building outside the reactor hall. Metallic natural uranium fuel is stored in a dry storage compartment in the bunker building. The rest, consisting of oxide fuel, is stored in a water-filled pond under floor level in the bunker building or in the water-filled fuel ponds in the reactor hall. Fuel unloaded from the reactor is cooled for 2 to 4 years in the fuel pond in the reactor hall, before it can be transferred to the dry storage compartment or the storage pond in the bunker building. The spent fuel is low to medium enriched, mostly around or below 6%, although enrichment levels of up to 13% have been used.

At Kjeller, spent fuel from the JEEP II reactor is stored in a dry storage facility consisting of a concrete block with several storage tubes covered with shielding plugs. The concrete block is located beneath a building specifically designated for loading and unloading of transports of radioactive material. From the time that the fuel is removed from the reactor until it is placed into dry storage, the fuel is cooled in water pools in the reactor hall.

Spent fuel from the former JEEP I and NORA reactors is stored at Kjeller in a similar storage facility located beneath another building at the site. The storage tubes in this storage location are surrounded mainly by sand instead of concrete; concrete is used only in the bottom and on top of the storage compartment.

[2] IFE is an independent foundation. Activities related to nuclear technology account for about 50% of IFE activity, petroleum technology about 30% and R&D in alternative energy about 20%. Parts of the funding for general research and radioactive waste handling come from various ministries. The HBWR is part of the OECD Halden Reactor Project, which is a co-sponsored research programme involving 18 countries, with the OECD Nuclear Energy Agency as the umbrella organisation. Main research activities at the OECD Halden Reactor Project are fuel and material safety research; and man, technology and organisational (MTO) research. The JEEP II reactor is used for basic research in physics and material science and for isotope production. IFE has an annual budget of around 500 MNOK (62 M€), of which around 20% is governmental funding. This basis provides the financial resources and staffing to operate the two research reactors and a waste treatment facility. At present, 28 persons are employed at JEEP II, 66 at HBWR and 6 at the waste treatment facility. Total staff employed at IFE number approximately 550 persons.



Facilities at the Halden site

Spent fuel storage facility (JEEP1, NORA)

Spent fuel storage facility. Kjeller site.

(ii) Spent fuel inventory

Table 1. Inventory of irradiated nuclear material in Norway as of 1 January 2005 (all figures in kg).

	MBA-A	MBA-B	MBA-C	Total IFE-Kjeller	Total IFE-Halden	Grand Total
Enriched uranium	238	1,650	3,145	1,888	3,145	5033
Natural uranium	0	1,208	78	1,208	78	1,286
Metallic uranium	0	3,125	6,918	3,125	6,918	10,043
Depleted uranium	0	2	15	2	15	17
Thorium	0	100	12	100	12	112
Total				**6,322**	**10,168**	**16,491**

(iii) Radioactive waste management facilities

At the IFE site at Kjeller the following facilities are in operation:

- Radioactive Waste Facility (built in 1959).
  This is a facility for receiving, sorting, handling, treatment and conditioning of radioactive waste, and is the only facility of this type in Norway. It receives all LILW generated by Norwegian industry, hospitals, universities, research organisations and military forces. LLW containing only naturally radioactive nuclides (TE-NORM) is not received at IFE.

- Storage Building 1 (built 1965–66)
  This building is 434 m^2 in size and is used for the storage of conditioned waste packages.

- Storage Building 2 (built 1977–78)
  In this building, there is an area (430 m^2) devoted to the storage of conditioned waste packages. It also contains an incinerator oven for combustible LLW. This oven is not in operation and considerations for the purchase of a new are ongoing. A separate part of the building contains the storage for non-irradiated uranium.

- KLDRA Himdalen (built 1997–98)
  This is the Combined Disposal and Storage facility for LILW in Himdalen, in Aurskog Høland municipality. It has been in operation since March 1999. The main purpose of the facility is direct disposal of conditioned waste packages. One fourth of the capacity of the facility is today for storage. When the political decision was taken to choose Himdalen for a disposal site it was also decided to allocate a part of the facility for storage where certain waste packages were to be placed. Waste packages placed in the hall for storage are all in "disposal-ready form" and will either be encased in concrete, as is done in the repository part of the facility, or retrieved for disposal at another site.

Radioactive waste facility.

(iv) Inventory

Norwegian legislation does not specify any criteria for the classification of radioactive waste. Instead, the classification provided in IAEA Safety Series No 111-G.1.1 "Classification of Radioactive Waste" is applied as far as is reasonably practicable. Given the long history of radioactive waste management in Norway, the IAEA criteria cannot be followed exactly for most earlier waste, mainly due to the higher content of long-lived alpha-emitting nuclides than specified in the IAEA criteria. This, however, has been taken duly into account when assessing the safety of the repository, both in the short and long term.

Historically the following categories were used by IFE: spent nuclear fuel, ion exchange resins, "Some sources" and the other wastes. The waste was segregated according to half-life:

Category I: ≤ 1 year
Category II: > 1 ≤ 30 years
Category III: > 30 years

Waste packages were sorted according to dose rate levels on the waste drum. For a contact dose rate of >10 mSv/hour, lead shielding is used inside the drums. A smaller drum, of steel with 2 cm of lead on the sides and 3 cm in the bottom and on the top, is placed inside the drum and 6 cm of concrete is poured between the drums. The ion exchange resin is then poured into the inner drum.

The older paper-based archives have now been converted into an electronic database. When waste is received, all data are registered – e.g. type of waste, amount and type of radionuclides, type of container and position in the repository or storage facility. Efforts are currently underway to achieve a more detailed overview of legacy waste, as well as better predictions of upcoming waste.

In the early days of the Norwegian nuclear programme, radioactive waste was defined by "Gross alpha" and "Gross beta". Later, amounts of uranium "U", plutonium "Pu", fission products "FP" and mixed fission products "MFP" were used. None of these categories can easily be converted to a level of radioactivity (MBq) using present classification system. It is difficult to evaluate the exact activity

concentrations in the former waste because of problems in estimating decay times. It has been decided to retain the old terms in connection with earlier waste. In the table below both old and new categories are used.

Table 2. The inventory of Norwegian radioactive waste as of 1 January 2005.

	Himdalen Repository (MBq)	Himdalen Storage (MBq)	IFE LILW-SL (MBq)	IFE LILW-LL (MBq)
Gross alpha*	3,695			
Am-241	309,395			
Ba-133	285			
Gross beta*	405,660			
C-14	40,537			
Cl-36	45			
Cm-244	1,595			
Co-60	11,944,654	3,219		
Cs-137	47,543,220	184,636		
Eu-152	454			
H-3	113,170,896			
Kr-85	217,175			
MFP*	131,479			
Ni-63	1,822			
Pu-239	1,991			
Ra-226	4,456			167,992
Sr-90	1,095,486	178,942		
U,Pu,FP*	2,279,183			
U-238	860	166		
Am/Be				4,002,775
Pu (mg)**	15,003 mg	35,026 mg		460mg
Total no. of 220-litre drums	4,030	166	20***	20

* = Historical categories, see above. Gross alpha includes also Pu. MFP = Mixed Fission Products
** Historical categorisation, still in use. Amounts of Plutonium are given in mg, and include Pu^{239} and Pu^{240}.
*** Under treatment, no specific activity can be given.

Remaining solutions of uranium containing some plutonium and fission products from the decommissioned reprocessing test facility are stored in stainless steel tanks in the radioactive waste treatment plant. The volume is approximately 1000 L and it is not specified in the table above.

Approximately 120 drum equivalents of waste are generated each year. Out of this 80 are from the activities at the IFE's sites and 40 from other and external generators.

(v) No nuclear facilities are in the process of being decommissioned in Norway.

Section E. Legislative and Regulatory Systems

Article 18. Implementing measures
Article 19. Legislative and regulatory framework

Norway is a constitutional monarchy with its executive branch headed by the King as head of State and the Prime Minister as appointed head of Government. The Prime Minister is supported by a council (cabinet), appointed by him with the approval of the Storting (the Norwegian Parliament). Laws are passed by the Storting, whereas regulations, directives and orders and certain licenses are generally made by the King in Council upon the advice of ministries and agencies of the Government.

NRPA is the Government's competent authority on matters concerning radiation protection and nuclear safety and security. It is organised under the Ministry of Health and Social Care (MOH), from which it receives its funding. NRPA provides assistance and advice to all ministries on matters related to radiation, radiation protection, waste management, nuclear safety and security.

All nuclear activities, including transboundary movements, are regulated by two legal instruments: the Act on Atomic Energy Activity of 12 May 1972 and the Act on Radiation Protection and Use of Radiation of 12 May 2000.

Act on Atomic Nuclear Activity of 12 May 1972

The Act on Atomic Energy Activity regulates the licensing regime, general requirements for licences, inspection regime and the legal basis for the regulatory body. Chapter III of the Act establishes the liability regime according to the Paris Convention of 29 July 1960 as amended and related international legal instruments. The final part of the Act regulates confidentiality and penalties in case of non-compliance. Pursuant to the Act, four regulations have been issued:

- Regulations of 2 November 1984 on the Physical Protection of Nuclear Material.
- Regulations of 15 November 1985 on Exemption from the Act on Atomic Energy Activity for Small Amounts of Nuclear Material.
- Regulations of 12 May 2000 on Possession, Transfer and Transportation of Nuclear Material and Dual-use Equipment.
- Regulations of 14 December 2001 on Financial Compensation after Nuclear Accidents.

The regulations of 2 November 1984 establish requirements for the physical protection of nuclear material and nuclear facilities. The regulations implement the obligations of the Convention of the Physical Protection of Nuclear Material. They are currently in the process of being revised.

The regulations of 15 November 1985 exempt small amounts of nuclear material from Chapter III of the Act and thus from the liability regime.

The regulations of 12 May 2000 deal with the control and accountancy of nuclear material, as required in the Additional Protocol to the Safeguards Agreement between Norway and the IAEA.

The regulations of 14 December 2001 concern how Contracting Parties to the Vienna Convention of 21 May 1963, Contracting Parties to the Joint Protocol of 21 September 1988 and Hong Kong shall be considered in connection to Norwegian legislation on nuclear liability. They also regulate how nuclear accidents in a non-party state shall be considered in connection with the Norwegian legislation.

Additionally, there is the Royal Decree of 22 December 1999 on "Licence for Operation of Nuclear Installations pursuant to the Act on Nuclear Energy Activity", issued to the Institute for Energy Technology. The licence expires on 31 December 2008. The main basis for the licence is the Safety Analysis Reports for the two reactors and related auxiliary facilities.

Act on Radiation Protection and Use of Radiation of 12 May 2000

The Act on Radiation Protection and Use of Radiation of 12 May 2000 constitutes the legal basis for regulating the use of ionising and non-ionising radiation, radiation protection requirements, medical use of radiation, contingency planning, waste management and discharges to the environment. The Act itself establishes the framework, which is spelt out in further detail by the regulations. Pursuant to the Act, two regulations have been issued:

- Regulations on Radiation Protection and Use of Radiation of 21 November 2003.
- Regulations on the Applicability of the Act on Radiation Protection and Use of Radiation on Svalbard and Jan Mayen of 9 May 2003.
- Regulations relating to Systematic Health, Environmental and Safety Activities in Enterprises of 6 December 1996.

The Royal Decree of 26 June 1998 establishes the organisation of the emergency preparedness system in Norway, under article 25.

According to Act of 14 June 1985 No. 77 on Planning and Building Activities with specific regulations concerning impact assessments of 1 April 2005 No. 276, nuclear power plants and other nuclear reactors, plants for handling of irradiated nuclear fuel, plants for production or enrichment of nuclear fuel, and installations for disposal of radioactive waste should always be subjected to an impact assessment. When planning an installation for collection, handling and storing of radioactive waste, one should consider carrying out an impact assessment. The decision on whether an impact assessment should be carried out is to be taken by the competent authority.

Neither the Acts nor the regulations are very specific in regulating spent fuel and waste issues. All details will have to be regulated by NRPA through guidelines and requirements associated with licences and approvals, with these being handled on a case-by-case basis.

Article 20. Regulatory body

As defined in the Act on Atomic Nuclear Activity, the regulatory body is NRPA, organised as a directorate under MOH. NRPA regulates matters concerning nuclear safety and security, nuclear emergency preparedness and radiation protection radioactive waste and spent fuel management.

The builder and owner of the combined disposal and storage facility in Himdalen is Statsbygg (Directorate of Public Construction and Property), which is organised under the Ministry of Modernisation. All organisations receive their funding from the respective ministries on a yearly basis following the Norwegian State Budget.

The Norwegian Radiation Protection Authority

NRPA currently has a total staff of currently 95 persons and a total annual budget of approximately 100 MNOK (12 M€). NRPA acts as a directorate under the Ministry of Foreign Affairs in assisting the latter in implementing its *Action Plan for Nuclear Safety in North West Russia*. In addition to this, NRPA receives funding from the Ministry of the Environment.

NRPA is organised in three departments, which are further divided into specialised sections:

- Department for Radiation Protection and Nuclear Safety
- Department for Emergency Preparedness and Environmental Radioactivity
- Department for Planning and Administration.

The Department for Radiation Protection and Nuclear Safety has the executive responsibility for the safety and security of Norway's nuclear facilities, industrial and medical use of radiation and radiation protection. It also handles licensing of shipments of nuclear material and issues approval certificates for transport packages. The staff of this department currently numbers 33 persons.

The Department for Emergency Preparedness and Environmental Radioactivity acts as the secretariat for organising emergency preparedness against nuclear accidents, ref. article 25. It is also responsible for environmental monitoring and assessment, as well as assessment of environmental and health consequences of discharges of radioactive substances from nuclear, industrial and medical facilities. The staff currently numbers 42 persons. NRPA has an Emergency Preparedness Unit at Svanhovd in Sør-Varanger near the Russian border in the far north-east, and an Environmental Unit at the Polar Environment Centre in Tromsø in northern Norway

NRPA handles applications for licences and renewal of licences for the operation of nuclear facilities. An application for a license to construct or operate a nuclear facility shall be sent to the Ministry of Health, whereupon NRPA as the competent authority will be requested by the Ministry to review the application. NRPA is responsible for issuing criteria and requirements and may also request additional investigations or information from the applicant. NRPA will then prepare a report for the Ministry with the result of the review of the application (safety reports, etc). In this report NRPA will specify any further requirements that the applicant should fulfil, and will give its recommendation to the Ministry as

to approval/rejection of the application. On the basis of this, the Ministry will prepare the documentation for a decision by the Government (actually by the King in Council).

Once the application is approved, a licence will be granted by the Government. Prior to starting operation, the licensee will need formal approval from NRPA. NRPA will carry out regular inspections and audits to ensure that licence requirements are fulfilled and complied with. NRPA is also responsible for the processing and approval of discharge licences for all nuclear facilities in Norway. NRPA is responsible for the State System of Accountancy and Control under the Safeguards Agreement between Norway and the IAEA.

NRPA is fully authorized through legislation to enter a nuclear installation and surrounding area, at any time, and to request the information necessary for the purpose of the inspection. To enable the requisite inspections to be carried out after operational interruptions or accidents, licensees shall provide reports to NRPA. Inspections are provided by NRPA also in response to the operator's request in cases of any intended changes in construction, operation or management which constitute a departure from approved conditions. NRPA inspections often focus on a specific activity. For example in connection with the retrieval of the waste drums, several inspections were performed. The Himdalen facility is normally inspected once or twice each year.

In recent years, priority has been given to system audits, following the same structure as such inspections in the non-nuclear field. The quality assurance of health, working environment and safety is monitored by auditing the management system for these areas. NRPA selects a certain subject or area for each given audit. In 2005 an audit was carried out at the IFE Kjeller site, with radioactive waste management as the subject and radiation doses as a sub-subject. No discrepancies were found, although some remarks were made.

NRPA may at any time independently communicate regulatory requirements, decisions and opinions to the public. It will, as appropriate, liaise with the regulatory bodies of other countries and with international organisations for cooperation and exchange of regulatory information. The IAEA Safety Standards Series are followed and implemented to the extent that they are applicable.

Dark spots: Nuclear facilities (above: Kjeller and Himdalen (26 km apart), below: Halden

Red spots: NRPA offices (below: headquarter)

Section F. Other General Safety Provisions

Article 21. Responsibility of the licence holder

IFE is the licence holder for Norway's two research reactors as well as the combined disposal and storage facility in Himdalen. It is the responsibility of IFE to ensure the highest possible levels of safety for all its nuclear facilities during operation, decommissioning and closure of facilities. Safety levels shall be in accordance with the licence requirements and appropriate international standards. A licence for operation is normally granted for specific time period, up till now a ten-year period has been the most common used. At the end of a licence period the operator must apply for a new licence. New/fully updated safety reports shall be sent to the Ministry with the licence renewal application.

IFE is required to send updated safety reports every third year to the Norwegian Radiation Protection Authority NRPA (NRPA) for evaluation and approval. The current licence for the IFE's nuclear facilities expires 31 December 2008 and the operation licence for the Himdalen facility expires in 2008. NRPA also issues discharge permits to IFE, requiring IFE to employ the best available technology to reduce discharges to levels as low as reasonably achievable. The licensee is also responsible for providing the necessary financial and human resources for maintaining safety and radiation protection at an appropriate level.

Article 22. Human and financial resources

Human and financial resources for NRPA are not explicitly covered by legislation. However the Norwegian regulatory body was established several decades ago, and today common law serves as the basis for its annual budget.

Most non-administrative staff members at NRPA hold higher university decrees. All new employees are required to complete an internal training course. Training is given by senior staff, and NRPA employees attend courses and/or seminars as needed. For certain specific tasks, external advisers or consultants may be contracted.

IFE provides the financial resources and staff to operate Norway's nuclear facilities (reactors, storage facilities, radioactive waste treatment plant) and the combined disposal and storage facility. It also organises the necessary training and refresher training of its personnel and pays a early fee to cover the most relevant functions in NRPA.

The role of NRPA is to supervise that the resources and training/refresher training provided by IFE are appropriate. The Atomic Energy Act authorises NRPA to impose sanctions on IFE in the event that safety standards are not maintained at an acceptable level.

No specific sanction criteria have been established. All NRPA requirements can be appealed to MOH: this is a general right in the Norwegian civil service system. NRPA may withdraw the permit to operate (for all or some facilities) as necessary if sanctions are not followed or safety standards are not adequate.

NRPA has the authority to impose fines, either as a one-time sum or on a *per diem* basis if its sanctions are not followed. In case of criminal activities, NRPA is to report to the police.

To the extent possible, the structure of the system in Norway follows the IAEA Safety Requirements.

Article 23. Quality assurance (QA)

IFE has established a system for quality assurance to cover its research reactors and waste facilities, and provides for all aspects of operating a nuclear facility. This QA system is supervised by the regulatory body (NRPA). The licensee must also fulfil Norwegian quality assurance requirements as to health, working environment and safety, as specified in other regulations.

IFE has a quality system that builds on and follows the ISO 9001-2000 standard, but IFE is not formally certified according to this standard. The system also follows the guidance given by the IAEA for quality systems. The quality assurance programme for the combined disposal and storage facility in Himdalen follows the principles set out in the IAEA Safety Series Requirement No WS-R-1.

IFE is responsible for implementing and maintaining a quality system according to the licence granted by the Norwegian Government. IFE performs self-assessment and internal audits of the system, whereas NRPA perform audits to verify that IFE procedures and its quality management system comply with the requirements specified in the licence and in laws and regulations. NRPA evaluation system follows the principles set out in the IAEA Safety Standards Series Requirements No. GS-R-1.

Article 24. Operational radiation protection

The national system for radiation-dose control for workers is based on the regulatory requirements that all workers who may receive more than 1 mSv per year are required to wear personal dosimeters. Radiation-dose control for the public is based on the regulatory requirement that practices must limit exposure, so that no individual may receive doses exceeding 0.25 mSv per year.

Optimisation of radiation protection is a general regulatory requirement in Norwegian legislation. In addition, provision is made for operational optimisation through several guidelines detailing specific technical requirements concerning shielding, work practices, protection devices, etc.

Norway's new radiation protection regulations entered into force on 1 January 2004. The regulations were based on international endorsed standards like the IAEA Safety Standards No. 115, dose limits from ICRP60 – as well as general requirements that radiation sources and equipment shall be produced according to latest version of applicable ISO and IEC standards. The new radiation protection regulations contain a general requirement that licensees must possess adequate radiation protection expertise. This general requirement is further elaborated in several guidelines, where more specific training requirements in the various fields of work are given.

According to the 2000 Act on Radiation Protection and Use of Radiation, the operator shall report radiation doses sustained by each worker annually to NRPA. These doses must be kept below ICRP limits (the 1990 Recommendations of the International Commission of Radiological Protection) for each worker. The facility operator should register the doses. In general, annual radiation doses should be below 20 mSv/year, but IFE has obtained permission from NRPA for certain workers employed in special working operations to exceed this limit as long as the 100 mSv/5-year limit is maintained. Such exceptions must be justified and expressly applied for. Pregnant workers have a dose limit of 1 mSv for the remainder of the pregnancy, i.e. after the pregnancy has been diagnosed. There are no particular dose limits for women of childbearing age.

IFE has developed a system of work planning to keep staff radiation doses as low as is reasonably achievable, especially during maintenance work. This has led to improvements in general radiation protection at the facility as well as lower doses sustained by staff.

The operational limits and conditions for the IFE's nuclear facilities are specified in licences and discharge permits in order to ensure that discharges are limited. Furthermore, specific measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment. The existing discharge approval (valid from 1.4.2003 through 31.12.2005) specifies that, with respect to the risk of radiation exposure to population groups as a consequence of discharges, the maximum permitted doses to the population group most likely to be exposed must fall below 1 µSv/year for liquid discharges and below 100 µSv/year in the case of discharges to the air, in which the dose contribution from iodine isotopes shall be below 10 µSv/year. This condition applies to the site at Kjeller and that in Halden. A separate set of criteria has been established for the facility in Himdalen. No radioactive discharges are permitted from the facility, but the resultant dose to the critical population group from any activity releases from the facility, after closure, should not exceed 1 µSv/year.

In addition to the discharge limits, the permits give warning levels for specified nuclides. When the discharge of the nuclides exceeds the warning level, IFE is to report to NRPA. If warning levels are exceeded, IFE shall re-evaluate its routines and if possible reduce discharges. The re-evaluation is to focus on internal control and general use of best available technology. IFE submits annual reports of environmental and discharge information to the regulatory body (NRPA). Information concerning discharges is available to the public on the IFE website (www.ife.no). The information (in Norwegian only) is updated four times a year.

Article 25. Emergency preparedness

IFE is responsible for organising plans for on-site emergency preparedness and response. Each site has adapted own plans, and exercises are conducted several times a year. The off-site response is planned by the local police authorities, the municipality and the County Governor, and is coordinated with the Crisis Committee (see below). Exercises are conducted every three years.

Based on the Royal Decree 26 June 1998, the Government has established an organisation made up of representatives of the following entities:

- the relevant Ministries
- the Ministerial Co-ordination Committee
- the Crisis Committee for Nuclear Accidents
- the Advisors to the Crisis Committee for Nuclear Accidents
- the Secretariat for the Crisis Committee
- the Regional Emergency Preparedness Organisations.

The Ministries are responsible for emergency preparedness in their sphere of competence. In order to deal effectively with the early phase of a nuclear accident, the Ministries have transferred responsibility for remedial action to the Crisis Committee for Nuclear Accidents.

The Ministerial Coordination Committee, headed by the Ministry of Health, is responsible for ensuring cooperation and coordination among the various Ministries.

The Crisis Committee for Nuclear Accidents is made up of representatives of the following institutions:

- the Norwegian Radiation Protection Authority
- the National Police Directorate
- the Ministry of Defence
- the Directorate for Civil Protection and Emergency Planning
- the Directorate for Health and Social Affairs
- the Norwegian Food Safety Authority.

The Crisis Committee is responsible for deciding on and implementing remedial actions in case of a nuclear incident or an impending nuclear accident that would represent a potential threat to Norway. It must organise the evacuation of the population if the situation represents a direct threat to health and life; provide shelter; administer stable iodine; block off and secure contaminated areas; in the short term, restrict the production and distribution of foodstuffs. NRPA heads the Committee. Wherever possible, the Committee is to consult with the Ministries before acting on such decisions.

The Crisis Committee for Nuclear Accidents operates with two levels of emergencies. No countermeasures are automatically implemented on the basis of declaration of level of emergency: countermeasures will be implemented on an ad hoc basis depending on assessments of the situation. The evaluation regarding the need for countermeasures is undertaken in respect of the off-site situation. On-site measures such as evacuation may be applied, based on the parameters of the facilities.[3]

The Advisors to the Crisis Committee for Nuclear Accidents are representatives of organisations and institutions with the expertise and responsibility required for an emergency organisation, as regards the management of nuclear accident situations and for further development and maintenance of emergency preparedness.
During accident situations, the Advisors are to:

[3] The work for harmonisation of the respective plans and the work on implementing the IAEA standard for emergency planning (GS-R-2) are actively ongoing.

- submit and make available all information, data and measurements of relevance to the emergency situations and make forecasts for radioactive dispersion, fallout and radiation doses to the public
- advise on preventing or reducing the radiological and economic consequences of a nuclear accident in Norway.

The Secretariat for the Crisis Committee (the Norwegian Radiation Protection Authority) is responsible, inter alia, for alerting the Nuclear Emergency Organisation. The Secretariat organises a 24-hr Officer on Duty Service.

The Regional Emergency Organisations, established under the direction of the County Governors, coordinate regional and local preparedness. They are responsible for planning and initiating countermeasures according to local needs and demands, and are to maintain continuous liaison with the Crisis Committee in an emergency situation.

Norway has a national automatic gamma-monitoring network, consisting of approx. 30 stations running continuously. The data acquired are directly available to the competent authority and the emergency response organisation. In addition Norway has five high-volume air samplers with alarm capability, GM-tubes on top of the filters.

A multilateral agreement has been established between Denmark, Estonia, Finland, Germany, Iceland, Latvia, Lithuania, Norway, Poland, Russia and Sweden , whereby all data from the national gamma-monitoring networks are are shared among the acceding states. Norway has established bilateral agreements on early notification and information exchange with Finland, Germany, Lithuania, the Netherlands, Poland, Russia, Sweden, Ukraine and United Kingdom. The texts in the various agreements differ slightly, but are all based on the 1986 IAEA Convention on Early Notification. These agreements shall ensure a direct first notification if an accident at a facility covered by the agreements should occur in the vicinity of Norway.

Article 26. Decommissioning

As part of the licensing requirements, in December 2004 IFE provided a plan for the decommissioning of its facilities. This document is now being reviewed by NRPA. These decommissioning plans follow the recommendations of the IAEA Safety Standards Series No. WS-G-2.1 at the level of "ongoing planning. Important factors in the current evaluation by NRPA of the decommissioning plans are financing, organisational matters, in particular related to future waste handling in Norway, how to maintain critical competence throughout the dismantling work and maintaining technology and infrastructure of historical and cultural importance.

Section G. Safety of Spent Fuel Management

Article 4. General safety requirements

Norwegian general safety requirements for the safety of spent fuel management follow the IAEA recommendations in the field. The operator of the research reactor programme, IFE, is responsible for the management of spent fuel from the two reactors. The principles and requirements are detailed in the safety analysis reports for IFE's management programme. These safety analysis reports constitute an integral part of IFE's licence as granted by the Norwegian government; hence the requirements set out in the safety analysis reports are mandatory. The principles stated in subsections (i) to (vii) are all adequately addressed in the safety analysis reports.

Article 5. Existing facilities

IFE has more than 50 years of experience in handling and storing spent fuel. To date, there have been no incidents at Norwegian facilities with respect to these activities. Spent fuel from the reactors is stored at the reactor sites. At the HBWR, spent fuel is stored in a bunker building outside the reactor hall. The 45-year-old metallic natural uranium fuel is stored inside the bunker within a dry storage compartment; the rest, which is oxide fuel, is partly kept in the dry storage, but most of the fuel is stored in a pool underneath the floor. There are also storage pools within the reactor hall. Water in the pools is continuously cooled, monitored and kept free from contamination. IFE has storage capacity for another 15 years or more of operation.

At Kjeller, the spent fuel from the JEEP II reactor has been placed in a dry storage facility consisting of a concrete block with several storage tubes covered by shielding plugs. The fuel stored here has a cooling period of at least 90 days and does not require further cooling beyond that provided by natural air circulation in the storage tubes. The concrete block is placed under a building specially designated for loading and unloading transport of radioactive material. Between removal from the reactor and emplacement in dry storage, the fuel is cooled in water pools in the reactor hall.

Spent fuel from the former JEEP I (1951–1967) and NORA (1961–1968) reactors is stored in a similar storage facility under another building at the site. The storage tubes in this facility are surrounded mainly by sand as opposed to concrete; concrete is used only in the bottom and on top of the storage. There is no activity at present in this storage.

Article 6. Siting of proposed facilities
Article 7. Design and construction of facilities

No new nuclear facilities have been proposed for Norway at the time of writing. The siting of a hypothetical facility for the storage or disposal of spent fuel in the future would be the result of a well-defined process following domestic legislation as well as recommendations made by the IAEA and other international agencies. In developing the criteria, the IAEA Safety Standards Series Requirements and

guidelines would be an important and integral part. All steps as prescribed in Articles 6 and 7 would then be followed, and other Contracting Parties to the Convention within the vicinity would be consulted.

Article 8. Assessment of safety of facilities

Before construction of a spent fuel management facility, an impact assessment is required. A licence for construction is also required, to be granted on the basis of a systematic safety assessment. It is the builder/owner of the facility that is responsible for carrying out the assessments. The authorities then review the safety reports, based on several safety assessments, in connection with the licence application. Plans for later decommissioning of the facility are required as a part of these assessments.

Before the facility can be commissioned, the operator must apply for a operating licence. The application must describe the systems necessary for safe operation and how the authorities' requirements will be fulfilled in safety report(s).

Before the start of operation, updated and detailed versions of the safety assessments must be prepared, reviewed and approved by the authorities. Permission to start can be granted by NRPA only after all documentation is in place and approved.

Article 9. Operation of facilities

The safety assessment of facilities is guided by the relevant IAEA recommendations. Safety analysis reports are updated on a regular basis, and reported to the regulatory body every three years. In line with the terms of the current licence, an impact assessment for the IFE's nuclear facilities has been conducted according to the Planning and Building Act. NRPA is the competent authority for this process. The notification, including a proposal for a study programme, has been subjected to a public inquiry. NRPA has determined the study programme after comments from the Ministry of the Environment. IFE delivered its impact assessment report in December 2004, and the report has now been the subject of a public hearing. NRPA is at present finalising the evaluation, taking into account responses from the public hearing.

At present, operation of the spent fuel facilities is considered part of the operation of the reactor plants, and is regulated through the operating licence the IFE nuclear facilities. The licence has been granted on the basis of the safety assessments. NRPA performs inspections to ensure that operation, monitoring and maintenance are in accordance with the requirements.

The radiation-dose limit to the public for the operation of such facilities is a part of the total limit for any discharge from reactor sites. These dose limits set targets for permissible doses from the operation of the facilities, and the fulfilment of these targets is documented in the safety analysis reports. If and when another facility is put into operation, the operating procedures will become a part of the licence for that facility. Any significant incidents must be directly reported, without undue delay to NRPA.

Decommissioning plans will be developed during the licence period. In the case of a new facility plans for decommissioning would be required at the planning stage.

Article 10. Disposal of spent fuel

A small portion of Norway's spent nuclear fuel was reprocessed in 1969 in Belgium. This fuel originated from HBWR. Today, spent fuel will be disposed of, as reprocessing is no longer considered a viable option for the management of spent fuel in Norway.

An governmentally appointed commission has made recommendations for a further strategy regarding the management of spent fuel (NOU 2001:30). This commission recommended the establishment of a central (long-term) storage facility for spent fuel aimed at storage for a timeframe of some 40 to 60 years. Thereafter the fuel would be transferred to a repository, which would be operationally ready by this time. To prepare a solid basis for the construction of such a repository, the commission recommended that further research be undertaken in the field of rock disposal of spent fuel, e.g. concerning borehole technologies. The commission also suggested that the operation of such a facility should be transferred to a new waste management organisation, which could also coordinate the research and public information activities. No suggestions were made as to where the new storage facility and/or disposal facility should be located.

As a first follow-up of the commission's recommendations, a study was performed in 2004 on possible technological solutions for a new central storage facility for spent fuel and long-lived waste. The study also offered more detailed recommendations concerning actions needed in order to establish a new central storage facility. The matter is supposed to be handled by the Ministry of Trade and Industry (MTI). The Norwegian regulatory authorities are also considering the future spent fuel and waste management policy, including the need for additional facilities, optimal use and organisation.

Section H. Safety of Radioactive Waste Management

Article 11. General safety requirements

Specific criteria are established by NRPA in connection with the licence review and the three-year status reports, and the discharge permits. The requirements are included in the safety analysis reports for both the radioactive waste management plant and the Himdalen facility. IAEA safety standards are used as guidance in issuing and reviewing the safety analysis reports.

A specific requirement and overarching premise for both currently operating and new facilities is that, for future generations, the burdens emanating from present-day nuclear activities shall not be greater than those permitted for the current generation.

Protective measures providing for the effective protection of individuals, society and the environment constitute an integral part of the national framework legislation with due regard to internationally endorsed criteria and standards.

Article 12. Existing facilities and past practices

The Norwegian facilities for radioactive waste management were built 25 to 40 years ago (except the Himdalen facility, which started operation in 1999), and have been continuously modernised with a view to safety enhancement. The Norwegian authorities have carried out regular inspections and reviewed and enforced safety procedures in connection with licence applications. These practices were also in effect at the time when the Joint Convention entered into force.

Radioactive waste management in Norway is primarily carried out by IFE at its Kjeller site. The Combined Disposal and Storage Facility is located at Himdalen, 25 kilometres from the Kjeller site.

<u>The Radioactive Waste Facility</u>

The Radioactive Waste Facility was built in 1959. This is a facility for receiving, sorting, handling, treatment and conditioning of radioactive waste. It receives all low- and intermediate-level waste (LILW) generated by Norwegian industry, hospitals, universities, research organisations and military forces. However, low-level waste containing only naturally radioactive nuclides (TE-NORM) is not received at IFE.

Remaining solutions of uranium containing plutonium and fission products from the decommissioned reprocessing test facility are stored in tanks in the radioactive waste treatment plant at the Kjeller site. The solution is stored in stainless steel tanks placed in trays with sufficient volume to collect any leakage. There are also moisture alarms in the trays. IFE has developed a process and constructed a treatment system for the treatment and "solidification" of the solutions, and this has been approved by NRPA The purpose is to separate uranium from the fission products and further treatment for the waste to be accepted for disposal.

A detailed procedure is established in order to solidify the solutions by adding ammonia, yielding "yellow cake". The solidification will start in 2005 and continue into 2006. The solidified uranium will be placed in a 110 L drum that will be placed into a 210 L drum and the space in between will be filled with concrete. These drums will be stored at the storage facilities at IFE until a disposal facility (or a new long-term storage facility) is available.

Storage Building 1

Storage building 1 was built in 1965–66 and has been in continuous operation. This building is 434 m^2 in size and is used for the storage of conditioned waste packages. When the Himdalen facility started operation in 1999, storage building 1 was filled with waste packages; these have now been disposed of at the Himdalen facility.

Storage Building 2

Storage building 2, built in 1977–78, has an area of 430 m^2 devoted to the storage of conditioned waste packages. It also contains an incinerator oven for combustible LLW, which has not been in operation for the past five years. A separate part of the building contains the storage for non-irradiated uranium. When the Himdalen facility started operation in 1999, also this facility was filled with waste packages now disposed of at the Himdalen facility. A separate part of the building contains the storage for non-irradiated uranium.

Combined Disposal and Storage Facility at Himdalen

The facility is built into a hillside in crystalline bedrock. It has four caverns (halls) for waste packages and one slightly inclined 150-metre long access tunnel for vehicles and personnel. All the caverns and the access tunnel have a monitored water drainage system. A service and control room with service functions for personnel and a visitor's room are located along the tunnel. The rock caverns are excavated in such a way that about 50 metres of rock covering remains. This natural geological covering is for protection against intruders, plane crashes and other untoward events, although it is not intended to act as a main barrier in long-term safety calculations. Long-term safety will rely on the engineered barriers.

In each cavern, two solid sarcophagi have been constructed with a concrete floor and walls. When a section of the sarcophagus has been filled, it is planned that a roof will be constructed. The roof of the sarcophagus will be shaped to shed infiltrating ground water, and a waterproof membrane will be affixed to the concrete roof. Three caverns will be used for waste disposal, with drums and containers stacked in four layers. When one layer in a sarcophagus section has been filled with waste packages, it will be encased in concrete.

One of the caverns is used for storage for certain waste packages (166 of the old, retrieved waste packages containing some plutonium). The decision whether to retrieve the waste in the storage cavern or dispose of it by encasing it in concrete will be made on the basis of experience during the operational period and the safety reports to be prepared for closure of the facility, expected about the year 2030. There are no plans to retrieve any of the waste placed into the storage facility during operation.

Total capacity of the facility is 2000 m^3 (approximately 10,000 210-litre drums) and it has been approved for a total inventory of 520 TBq.

For the long-term safety of the facility, the Norwegian legal system stipulates two basic requirements that must be fulfilled:

- Future generations have the right to the same level of radiation protection as the present generation.
- Except for a certain period of institutional control of 300 to 500 years, the safety of the facility should not rely on future surveillance and maintenance.

Safety criteria set by the Norwegian authorities are as follows:

- For the most likely scenarios and based on realistic calculations, doses to the most exposed individuals should not exceed 1 μSv per year.
- For other scenarios, a dose of 100 μSv per year to the potentially most exposed individuals should not be exceeded.

The dose criteria are lower than those used and internationally recommended. One reason for this is to keep dose limits at the same level as the dose criteria regulating the discharge levels at the IFE facilities. The radiation emitted by the waste should not yield higher doses than the normal operation of the reactors. The principle of ALARA is also applied. It is possible to achieve these low levels because of the relatively low level of activity of the inventory in the repository.

Retrieval of a near-surface LILW repository

As a result of the discussions preceding the construction of the Combined Disposal and Storage facility at Himdalen, the Storting (the Norwegian Parliament) decided that a shallow ground repository on the IFE premises at Kjeller should be retrieved and its contents transferred to Himdalen. The repository contained 997 drums and 19 other items of low- and intermediate-level radioactive waste that had been buried in clay in 1970. Retrieval of the drums started in August 2001 and was completed after 11 weeks of work. NRPA as well as the local community and media were kept informed throughout the process.

The waste drums proved to be in remarkably good condition, and the handling of them caused no significant problems. The original drums were cemented into slightly larger drums prior to preliminary storage at IFE and subsequent transport to Himdalen. Radiological monitoring of the remaining clay in the hole showed contamination far below the relevant clearance levels granted by NRPA. The total dose received by the involved personnel was less than 2.1 millimansievert. The total cost of retrieval, repacking, internal transport and radiological and environmental control was 3.6 million NOK.[4]

Of the 997 drums, 166 were "plutonium drums", containing a total of 35 grams of plutonium-239/240 originating from the former Uranium Reprocessing Pilot Plant's treatment of spent fuel from the first JEEP reactor. In accordance with the same parliamentary decision, these drums have been placed in the storage hall of the Himdalen facility.

[4] The Himdalen-related costs (transport and disposal/storage) are not included here.

Environmental clean-up

In the early spring of 2000, IFE at Kjeller removed from the bed of the nearby Nitelva River approx. 180 m^3 of sediment contaminated by plutonium from liquid waste discharges in the years 1967–70. The liquid waste had been generated in conjunction with the operation of the Uranium Reprocessing Pilot Plant, which was shut down in 1968. NRPA required that sediments with a concentration of plutonium and americium isotopes (^{239}Pu, ^{240}Pu and ^{241}Am) exceeding 10 Bq/g were to be removed from the riverbed. This part of the riverbed had been accessible to the public in recent years due to low river-water levels for a few weeks every spring. Thus NRPA considered the contaminated sediment a potential risk to the public, even though the hot spots were now more than 50 cm below the sediment surface. The most contaminated volume of sediment (16 m^3), with a mean concentration of about 50 Bq/g and hot spots of the order of 100-1000 Bq/g, has now been disposed of at Himdalen. The remainder, with a mean concentration of about 2 Bq/g, was mixed with non-contaminated soil and clay and then used as filling compound in the hole left after retrieval of the 997 drums from the near-surface repository in 2001. The costs of the clean-up operation were approximately 4 million NOK.

Later that year, IFE decided to retrieve the 900-metre long section of a liquid waste discharge pipeline buried in the bed of the Nitelva River. It was no longer in use, having been replaced in 2000 by a new and shorter pipeline leading to a new discharge point about 800 m upstream of the old one. The clean-up operation was performed in March 2001. The retrieved pipeline was cut into two-metre long pieces and brought to the Radioactive Waste Treatment Plant at IFE. Plutonium-contaminated sediment was detected at one location. The concentration spot exceeded the NRPA's clearance levels granted for Nitelva River sediment. About 40 m^3 of sediment were therefore removed and transported to IFE for treatment and subsequent disposal at the Himdalen facility. The costs of this second clean-up operation were about 0.8 million NOK. Considerable effort was expended to provide information to the media and the local community throughout the process.

Retrieval of waste drums at the Kjeller site.

Article 13. Siting of proposed facilities
Article 14. Design and construction of facilities

Before any new facilities for nuclear activities can be built in Norway, all obligations in these articles must be met, and decommissioning plans prepared. Among these obligations is the requirement to consult the Convention Contracting Parties in the vicinity. For the siting, design and construction of a major facility for radioactive waste management, the same procedures as described under articles 6,7 and 8 are to be followed. At present, Norway has no plans for constructing any new waste management facilities. Although some initial planes exist, as described in other sections, about a (long term) storage facility for spent fuel. This facility is expected to also have storage capacities for radioactive wastes.

Article 15. Assessment of safety of facilities

The Combined Disposal and Storage Facility for LILW at Himdalen is the most recent waste management facility constructed in Norway. Site selection and the assessments made in connection with construction of the facility are described in the following.

The process of selecting a site for the disposal of low- and intermediate-level radioactive waste in Norway started in 1989, when a steering committee was appointed by the Government to investigate solutions for final disposal of all Norwegian low- and intermediate-level waste.

In 1992, the Directorate of Public Construction and Property (Statsbygg) prepared its impact assessment for a repository for Norway's low- and intermediate-level waste in accordance with the Planning and Building Act. Three sites – the Killingdal Mine, and the Kukollen and Himdalen sites in the vicinity of Kjeller— were evaluated. The steering committee nominated Himdalen, 25 km from the Kjeller waste conditioning plant, as the preferred site, and recommended that an engineered rock cavity facility be located there. During the parliamentary committee deliberations on this recommendation it was proposed that the new facility should be a combined disposal and storage facility, with capability for storing some plutonium-bearing waste and disposing of the short-lived waste.

In April 1994 the Storting decided that at the Himdalen site there should be a combined facility, and that technical investigations should be undertaken there. It had also been recommended that an IAEA–WATRP (Waste Management Assessment and Technical Review Programme) review should be performed before granting any construction licence; in December 1994, NRPA sent such a request to the IAEA. The scope of the review included review of the legal framework, long-term safety and the site selection process. In September 1995, a review meeting was convened in Oslo, where the WATRP team and IAEA representatives met with Norwegian experts and also visited the Himdalen site. Within the scope of the review, the team declared itself satisfied with the overall approach taken by the involved Norwegian organisations in the development of a storage and disposal facility for LILW. On the basis of the information existing, it was the opinion of the review team that the Himdalen site, in combination with the engineering concept (sarcophagus), could be suitable for the storage and disposal of the relatively small amounts of Norwegian LILW. The review team emphasised that it was necessary only to find a

suitable site, as finding the best site would not be possible. Further details can be found in Strålevern Report no 1995:10

In accordance with the Act on Nuclear Energy Activities, Statsbygg's application for a building licence along with the safety analysis reports was sent to NRPA in March 1996. The licence was granted in February 1997 and construction started soon afterwards.

In July 1997, IFE's application for a licence to operate the facility was sent along with the safety report to NRPA. The licence was granted in April 1998. Statsbygg's safety report, with updated safety analyses and verification of site-specific criteria, was sent to NRPA in September 1998. In March 1999 all the necessary documentation was in place and NRPA granted IFE permission to begin operation. IFE operating licence is valid for a 10-year period.

Article 16. Operation of facilities

Some waste management facilities were constructed before the Act on Nuclear Energy Activities entered into force in 1972, so this law could not regulate the original design and initial construction of the facilities. Nevertheless, the design and construction of the Norwegian facilities have been consistent with international practice. Later modifications have been subject to approval by NRPA and regulated through operational limits and conditions in accordance with the Act and requirements stipulated in the licences.

In the case of the Himdalen facility constructed in 1997–98, the licence to operate the facility is based on safety assessments as specified in Article 15. The findings obtained during operation of the facility will be used to verify and review the validation assumptions and to update the safety assessments for the period after closure.

Any incidents at the waste management facilities or at the Himdalen facility are to be reported directly to NRPA, without undue delay. For the waste management facilities at the IFE's Kjeller site, decommissioning plans at the level of "ongoing planning" were prepared in 2004 by the operator, IFE, and sent to NRPA for review and approval.

Article 17. Institutional measures after closure

The Himdalen disposal facility is owned by the state (Statsbygg as of today), so the responsibility for post-closure measures will rest with the state. As yet, no decision has been taken concerning the form in which information and records will be kept.

An institutional control period of 300–500 years will be effected for the Himdalen disposal facility (exact length to be determined at the time of closure). Monitoring of the area will be implemented, and there will also be restrictions on land-use.

Section I. Transboundary Movement

Article 27. Transboundary movement.

All nuclear activities, including transboundary movements, are regulated by the Act of 12 May 1972 No. 28 on Nuclear Energy Activities with regulations, and the Act of 12 May 2000 No. 36 on Radiation Protection and Use of Radiation with regulations.

Norway does not export spent nuclear fuel or radioactive waste. However, irradiated nuclear fuel as test specimens as part of the bilateral research programme at IFE are imported from participants in the OECD Halden Reactor Project for further irradiation at the Halden Boiling Water Reactor. After irradiation, these specimens are usually exported back to the owner for further investigation and study. A few of these specimens are studied at the laboratories at Kjeller. This generates some small amounts of waste, which are disposed of together with the low- and intermediate level waste. Some of the waste, generated in connection with the examinations, is repacked and returned to the owner of the spent fuel. The Spent Fuel that is imported and exported to and from Norway is owned by the 20 countries participating in the OECD Halden Project.

All transfers to and from foreign countries must be authorised by the regulatory body, also to ensure compliance with the provisions of the Convention on the Physical Protection of Nuclear Materials and other relevant conventions.

Export of radioactive waste require authorisation. Transit transportation in Norway of nuclear material in general is not permitted without a licence. To date, such transits have never been performed.

Section J. Disused Sealed Sources

Article 28 Disused sealed sources

Regulations on Radiation Protection and Use of Radiation (21.11.2003) specify NRPA as the regulatory body for all aspects of handling radioactive sources. This regulation distinguishes between very low, medium and high activity sealed sources. Authorization is needed before using a high-activity sealed source: 1,000,000 times of the exemption values given as part of the regulation, roughly similar to levels set out in IAEA Safety Series No. 115. Notification must be sent to the authority (NRPA) in case of use of a medium-high activity source, these are typically industrial gauges. For very low activity sources, no authorization or notification is needed; such sources are generally below the regulation exemption levels.

NRPA maintains electronic records of sealed sources used in industrial radiography, oil and gas well logging and medical therapy. Industrial gauges and blood irradiators are also registered. Information on sealed sources used in other ranges of application is kept in manual (non-digital) form in the NRPA archives. This is not optimal, but because Norway is a small country with only a limited number of sources, it may be considered adequate. Resources are now being put into developing an electronic web-based central register of radiation sources. The web-based register will enable the owners and users of radiation sources to make applications and notifications to NRPA directly on the web. Owners and users will also be able to check and verify the NRPA register. The register will be tested in 2005 and 2006, and is planned to be in operation from 2007.

Distributors of medium and high activity sources are required to have authorisation from NRPA. When NRPA issues authorisations for companies to buy, sell or use sealed sources, it is with the requirement that disused sources are to be returned to the manufacturer. This is strictly enforced, in particular in regard to Am-241 sources. However, if no viable options for a license holder in Norway are available, NRPA may decide that that the source is to be stored at Kjeller, pending the availability of a disposal facility for spent fuel and long-lived waste

It is the responsibility of the licence holder to ensure that disused sealed sources are handled in a safe manner and that they are ultimately returned to the manufacturer or sent to IFE. If the license holder is in financial difficulty or out of business, safety and proper disposal of the disused sealed sources will be handled by a case-by-case basis. NRPA may take the responsibility for the source(s). License holders are not required to provide financial assurance for the decommissioning of their facility and disposal of disused sources when applying for a license. So far this has not caused any major problems in Norway.

Practical implementation of the return requirement means that the sources are re-exported to a manufacturer abroad or sent to IFE for treatment and for storage or disposal at the Himdalen repository, if the source complies with the requirements set out in the license for Himdalen. The waste treatment plant at IFE can treat, store and dispose of disused sealed sources in a safe manner. (Disused sealed sources are treated at the same place as other wastes.) The same regulatory requirements as for other

radioactive wastes are in force for long-term storage facilities for disused sealed sources. The same safety precautions, including monitoring activities, are required during handling of disused sealed sources.

The owner pays for the treatment and storage at IFE. The cost for disposal at Himdalen is covered by government funding, the MTI has a separate agreement with IFE for the operation of the Himdalen facility and general waste handling.

The only one producer of radioactive sources in Norway: this is IFE, which produces sources at the Jeep II reactor. IFE's licence for this production is part of the general licence to own and operate nuclear installations. The general licence contains comprehensive requirements for radiation protection, safety and security. As a distributor of radioactive sources, IFE is also required to provide annual reports to NRPA specifying sources, activities, names of buyers etc.

Norway, Norwegian authorities, allows re-entry of disused sealed sources on a case-by-case basis. Norwegian-produced instruments, with a sealed source that may be produced in a third country, will also be permitted re-entry.

Orphan sources have rarely been identified in Norway. However, NRPA has registered that many licensees do not inform the regulatory authorities when operations are closed down and installations are being decommissioned. Thus, NRPA has noted several instances where sources has been removed or sent to other companies without proper notification, as stipulated by the regulations in force. If an orphan source is found, the normal procedure is that NRPA attempts to find the owner, and, if relevant, also report the case to the police. If the owner is not found, NRPA makes sure the source is being handled properly as radioactive waste.

If the source is found to be orphaned, deliberately or by an act of negligence, the police shall consider prosecution and further reactions. To date NRPA has not experienced any such cases.

At the Storskog border point (Norway–Russia) a monitoring portal has been in operation for almost two years now. The customs have portable measuring equipment at their stations across the country. Several other governmental organisations have similar handheld equipment, for example Coast Guard and Civil Defence organisations. NRPA assists them (second-line services) in case of alarms. Most private companies dealing with scrap metal or other businesses that might have contaminated waste have equipment/control monitors to detect such sources before they have been sent to a foundry or are being melted down.

Section K. Planned Activities to improve Safety

It is a general goal to further improve the operational safety of Norwegian nuclear installations. There are at present no special ongoing activities aimed at improving safety. However, when assessing plans for the development and refurbishing of the country's nuclear installations, improved safety will be a main priority.

Section L. Annex

References to national laws, regulations, requirements, guides etc.

Act of 12 May 1972 No. 28 on Nuclear Energy Activities

- Regulations of 2 November 1984 on the Physical Protection of Nuclear Material.
- Regulations of 15 November 1985 on Exemption from the Act on Atomic Energy Activity for Small Amounts of Nuclear Material.
- Regulations of 12 May 2000 on Possession, Transfer and Transportation of Nuclear Material and Dual-use Equipment.
- Regulations of 14 December 2001 on Economical Compensation after Nuclear Accidents

Act of 12 May 2000 No. 36 on Radiation Protection and Use of Radiation

- Regulations on Radiation Protection and Use of Radiation of 21 November 2003.
- Regulations on the Applicability of the Act on Radiation Protection and Use of Radiation on Svalbard and Jan Mayen of 9 May 2003.

Norwegian Radiation Protection Authority (STATENS STRÅLEVERN), Treårig tilstandsrapport for konsesjonsbelagte anlegg ved Institutt for energiteknikk (Report 2003:6) *in Norwegian* ("the 3 year status report for the licenced faciliites at IFE").

Norwegian Radiation Protection Authority (STATENS STÅLEVERN), Norwegian work on establishing a combined storage and disposal facility for low and intermediate level waste (Report 1995:10), IAEA-WATRP review team, (1995).

NOU 2001:30 (Official Norwegian Report), Evaluation of strategies for final disposal of high level reactor fuel (in Norwegian).