Radioactive Waste Management

Nuclear Waste Bulletin

Update on Waste Management Policies and Programmes

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NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and the Republic of Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consists of 27 OECD Member countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

- to assist its Member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

EDITOR'S NOTE

The NEA *Nuclear Waste Bulletin* is prepared by the Radiation Protection and Radioactive Waste Management Division of the OECD Nuclear Energy Agency in order to provide a means of communication amongst the various technical and policy groups within the radioactive waste management community. It delivers concise information on current activities, policies and programmes in 18 NEA Member countries and 3 international organisations. It also provides biennial updates of progress in the development of technologies for the management and disposal of radioactive waste. Furthermore, each edition contains a full report of the status of radioactive waste management in a specific country.

The Bulletin includes four sections:

- Country highlights;
- Country focus;
- National programmes and policies;
- International organisation activities.

As each edition of the Bulletin does not include an exhaustive description of all national programmes, the reader is invited to consult previous bulletins and, if necessary, to contact national correspondents in order to obtain more information. The information presented herein reflects the situation as of March 2000.

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COUNTRY HIGHLIGHTS

AUSTRALIA

- The Government is currently progressing the study to identify a suitable site for a national radioactive waste repository for the near-surface disposal of low-level waste (LLW) and short-lived intermediate-level waste (ILW). Investigative drilling commenced in 1999 and a preferred site is expected to be selected in late 2000.

- The search for a site for the storage of long-lived ILW started during 2000. The identification of a preferred site is expected during 2002, with construction in 2005.

- Successive Australian Governments have agreed that Australia should not accept the radioactive wastes of other countries.

- ANSTO is continuing to collaborate with Lawrence Livermore National Laboratory on the development of a ceramic waste form for the immobilisation of surplus weapons plutonium.

BELGIUM

- Under the new Belgium federal government, installed on 14 July 1999, the Secretary of State for Energy acts as the general supervising authority of ONDRAF/NIRAS. The Minister of the Interior acts as supervising authority for the nuclear safety aspects and the Minister of Employment as supervising authority, as far as the technical safety of the nuclear facilities is concerned.

- The general rules for the establishment of acceptance criteria for non-conditioned and conditioned waste were approved by the competent authorities and were implemented on 10 February 1999.

- The first repatriation transports of the conditioned vitrified waste resulting from the reprocessing in France of Belgian spent fuel took place in March 2000.

- ONDRAF/NIRAS has concentrated its research on existing nuclear sites and the development of local partnerships. On 30 September 1999, a first partnership was signed between ONDRAF/NIRAS and the local authorities of Dessel.

- Important progress was made with the development of the infrastructure necessary for the realisation of the PRACLAY-demonstration programme.

- The Ampère commission, set up by the Minister in charge of energy policy to formulate recommendations with regard to Belgium's energy future, continued its activities and started with the first preparation of its report to the federal government.

CANADA

- The Nuclear Safety and Control Act, replacing the existing Atomic Energy Control Act of 1946, is expected to be promulgated in mid-2000, after the new regulations pursuant to the Act have been approved.

- On May 31, 2000 the Atomic Energy Control Board (AECB) officially became the Canadian Nuclear Safety Commission (CNSC).

- Despite a continuation of poor market conditions, the transition to new, high-grade uranium production centres continued in Canada.

- The Government of Canada announced its three key policy objectives for proceeding with the next steps on the long-term management. The Minister of Natural Resources initiated a consultative process to develop options on oversight implementation mechanisms, to meet the three objectives. Consultations with stakeholder, including waste producers and owners and the public, took place.

CZECH REPUBLIC

- The Radioactive Waste Repository authority (RAWRA) became the owner of all three repositories (Dukovany, Richard and Bratrstvi) in the Czech Republic, and began their operations on January 1, 2000.

- RAWRA prepared a proposal of the National Policy of the Czech Republic in the field of RWM in 1999 and sent it to the Ministry of Industry and Trade for comments.

- Testing of the new database and information system on radioactive waste began in April 2000.

- The generic conceptual design of the deep geological repository in a non-specific site has been completed, including an Environmental Impact Assessment (EIA) and a time schedule and budget for its realisation.

- The licensing of the Second Spent Fuel Interim Storage at the Dukovany site is in process.

FINLAND

- As part of a Decision in Principle (DiP), the first authorisation step towards a final repository of nuclear waste, an EIA addressing all four candidate sites was completed and accepted by the Minister of Trade and Industry (MiTI) in November 1999.

- The application of the DiP for the Eurajoki disposal site was submitted in May 1999 by Posiva Ltd and approved by the council of the host municipality, Eurajoki, in January 2000. The Radiation and Nuclear Safety authority (STUK) submitted its preliminary safety appraisal related to the DiP application.

- The latest cost estimates for the future management of nuclear waste, based on waste quantities at the end of 1999 and decommissioning of Nuclear Power Plants (NPPs), arise to about FIM 6 600 million (USD 1 100 million) with no discounting.

- Updated decommissioning plans must be submitted to the authorities for review at regular intervals of five years; the latest reporting took place at the end of 1998.

- The operation license of the low and intermediate-level waste (L/ILW) disposal facility at the Loviisa NPP was granted in1998.

FRANCE

- A bill concerning transparency and the safety and control of nuclear activities and leading to a new organisation of the control of nuclear safety is in preparation.

- The government signed, on 3 August 1999, three decrees:
  - authorising ANDRA to implement and operate at the Bure site, in eastern France, an underground laboratory in order to study deep geological formations where radioactive waste could be disposed of;
  - giving general guidelines to set up local committees in charge of following the activities implemented in underground laboratories;
  - deciding the creation of a commission composed of three members in charge of the dialogue prior to selecting one or several granitic site for a second underground laboratory.

  Concerning the first decree, the French Government granted, on 7 August 2000, the authorisation to ANDRA to sink the shafts of the underground laboratory.

- ANDRA and France-Déchêt announced in 1999 the creation of a partnership to create a dedicated very low-level waste (VLLW) repository next to the Aube Disposal Centre.

- The definitive operating license for the Aube Disposal Centre was granted on 2 September 1999. Taking into account the experience of feedback and the final safety report of the Aube Disposal Centre, the RFsIII.2.e is currently being revised.

GERMANY

- In June 2000, a basic document on nuclear consensus in Germany between the Federal Government and the utilities was agreed upon, which limits the future utilisation of the existing nuclear power plants (phase-out).

- The Federal Minister for Economics and Technology (BMWi) has taken over from the Federal Minister for Education and Research (BMBF) basic research and development for radioactive waste disposal.

- The Federal Minister of the Environment (BMU) plans to interrupt the exploration work on the suitability of the Gorleben site for final disposal of all types of radioactive waste.

- The Magdeburg Higher Administrative Court (OVG) decided that storage of radioactive wastes in the eastern parts of the Morsleben ultimate storage site (ERAM) was to be stopped in September 1998. Emplacement operations are not expected to be resumed.
- A comprehensive amendment of the Radiological Protection Ordinance is currently taking place in view of the implementation of the EURATOM basic safety standard.
- With regard to naturally occurring radioactive materials (NORM) residues, it is planned that there will be a graded control system dependent on the type of material and its radioactive concentration for inclusion in, and exemption from, the scope of nuclear and radiation legislation.
- A national plan for the orderly disposal of nuclear waste is being developed.

HUNGARY

- The Geological Institute of Hungary recommended at the end of 1998 that detailed work on the geological and site properties should start in the Uveghuta research area.
- The main results of the WATRP (Waste Management Assessment and Technical Review Programme) mission to carry out a peer review for the validation of the activities and results of the site selection and to give recommendations based on international good practice were presented to the press.

ITALY

- A site selection process to identify a suitable site for location of a LLW repository and interim storage for high-level waste (HLW) and spent fuel is on-going.
- The conditioning of the LLW and HLW wastes stored at the ENEL and ENEA sites and the decommissioning of the facilities is under way.
- ENEA has under way a licensing procedure for a dry storage system for the spent fuel presently stored in a pond at the Trisaia Centre.
- In November 1999 the previous ENEL subsidiary SOGIN became a formally independent company for managing the former nuclear activity of ENEL.

JAPAN

- In June 1999, the Atomic Energy Commission (AEC) started discussions to make a new long-term programme of research, development and utilisation of nuclear energy.
- JNFL is permitted to dispose of 400,000 drums at the Rokkasho Centre, and has already buried 130 000 drums of homogeneous waste from nuclear power plants at the end of 1999.

- The Special Committee on the Safety Standards of Radioactive Waste, the NSC, issued the report entitled “Clearance Levels for Solidified Materials Arising from Nuclear Reactors in Japan” in March 1999.

- After the international peer review by OECD/NEA, the H12 report was finalised in November 1999.

- In parallel with the R&D programme, an implementing organisation for HLW disposal will be established at the end of the year 2000 to site a repository.

- On March 3 1999, an interim report on “How to institutionalise disposal business of high-level radioactive waste” was completed. Following the report the Ministry of International Trade and Industry (MITI) is preparing a bill about HLW disposal.

- The oldest commercial gas-cooled nuclear power plant, Tokai Power Station, completed its commercial use in March 1998 and its decommissioning plan is being prepared.

- The STA is holding a series of symposia with AEC special advisors on the subject of radioactive waste to enhance public understanding of HLW disposal.

KOREA

- Restructuring of relevant laws for radioactive waste management took place in 1999.

- The relevant R&D activities for the HLW disposal at KAERI (Korea Atomic Energy Research Institute) consist of three fields: geoscience environment research, system development and performance assessment, and radionuclide migration study.

- By the result coming from the screening process for identifying rock types for HLW repository, the primary host rock will be Mesozoic plutonic rocks, the second choice will be gneissic rocks among the Precambrian basement.

- The decommissioning plan of TRIGA Mark-II and III was submitted to MOST (Ministry of Science and Technology) for a license at the end of 1999 and reviewed by KINS in 1999. The review report was again reviewed by the expert group for radiation environment in January 2000.

THE NETHERLANDS

- There is still no official government point of view on the decommissioning strategy of the “Dodewaard” nuclear power station.

- As it stands now, all existing reprocessing contracts will be honoured.

- By Royal Decree of 21 June 1999, maintenance of the Nuclear Energy Act and all regulations based on it, with a few exceptions, have been transferred from the Ministry of Economic Affairs to the Ministry of Housing, Spatial Planning and the Environment.

- With transfer of the Nuclear Safety Division from the Ministry of Social Affairs and Employment to the Ministry of Housing, Spatial Planning and the Environment in July 2000, the main bodies for inspection and enforcement are under the same Ministry.

- The COVRA research programme is due to be completed with the publication of the main report by the end of 2000.

NORWAY

- The national combined repository and storage facility L/ILW at Himdalen was inaugurated 24 September 1998 and the transport of the first waste container took place in March 1999.

- In December 1999, the Government granted a renewed license for operation of the research reactors in Halden and Kjeller.

SPAIN

- The 5th General Radioactive Waste Plan was approved by the Government on 31 July, 1999. No decision on the final solution of spent fuel and HLW will be taken before 2010. A Centralised Interim Storage facility will be available by the year 2040, not only to store the spent fuel but also to accommodate different waste and materials not amenable to be disposed of at the EI Cabril disposal facility.

- In compliance with the renewed operation permit a new Safety Analysis of the installation in the El Cabril disposal facility is being performed.

- The strategy for the dismantling of Vandellos I nuclear power plant was confirmed to release 80% of the site during the initial phase, followed by a waiting period of some 30 years before undertaking the total dismantling.

- The ENRESA-2000 Performance Assessment exercise is meant to be the focal point to orient future R&D projects.

SWEDEN

- Operation at Unit 1 of the Barseback nuclear power plant was permanently terminated in November 1999.

- SKB presented to the authorities, in December 1999, an analysis of long-term safety of the KBS-3 method for spent fuel disposal. This study, SR 97, has been submitted to an International Peer Review organised by OECD/NEA and is being reviewed by SKI and SSI.

- Feasibility studies to evaluate what siting of a deep repository would mean locally are presently going on in six Swedish communities. The report is to be finalised during year 2000.

- SKB received permission to extend the storage capacity of the central interim storage facility for spent fuel (CLAB stage 2).

- SSI's Regulations (SSI FS 1998:1) on the Protection of Human Health and the Environment in Connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste entered into force on 1 February 1999.

- SKI is preparing new regulations on the long-term safety of final disposal of spent fuel and nuclear waste.

SWITZERLAND

- The successful realisation of the interim storage facility, ZWILAG, relieves the time-pressure for establishing final disposal routes.

- The next milestone of the HLW programme is to demonstrate that sites for a repository in Switzerland exist and can be identified with a high degree of reliability.

- The results of the 1 050 m deep borehole at Benken together with the results of a 3-D seismic survey over an area of about 50 square kilometers around Benken and the results from the Mont Terri Project provide an excellent and very promising database to assess the feasibility of a HLW repository in Opalinus Clay.

- Within the scope of Phase V which is expected to last until 2002 at the Grimsel rock laboratory, a variety of experiments are underway in collaboration with partners from other countries. Furthermore, an international project under the patronage of the Swiss National Hydrological and Geological Survey is underway at Mt. Terri (Canton Jura).

- The expert group, EKRA, presented its final report in early February 2000. This report evaluates the options for long-term waste storage of both L/ILW and HLW as input for the revision of the nuclear energy law and for the decision on how to proceed with Wellenberg.

UNITED KINGDOM

- On 25 October 1999, the Government issued its response to the House of Lords Select Committee on Science and Technology report on "The Management of Nuclear Waste".

- The UK Centre for Economic and Environmental Development (CEED) Consensus Conference on Radioactive Waste Management took place on 21-24 May 1999.

- On 28 February 2000, the Environment Council published the interim reports of the Waste and Discharges Working Groups from the BNFL Stakeholder Dialogue process.

UNITED STATES OF AMERICA

- After two decades of development, WIPP opened for disposal operations in March 1999. Its capacity is about 175 000 cubic meters, and will take about 30 years to fill.

- The State of New Mexico issued a permit that will allow for mixed waste to be received at WIPP providing the waste meets the WIPP acceptance criteria for transuranic waste.

- On 27 August 1999, the Environmental Protection Agency (EPA) published proposed radiation protection standards, 10 CFR Part 197, for a repository at Yucca Mountain.

- The Yucca Mountain Programme adopted an approach for a "cooler" repository which allows for repository closure after 50 years or to remain open for as long as 300 years, depending on the results obtained from performance confirmation monitoring and the views of future generations.

- The DOE Draft Environmental Impact Statement (DEIS) for a Geologic Repository on Spent Nuclear Fuel and High-Level Waste was issued for public comment and DOE is in the process of reviewing the input and will prepare a Final Environmental Impact Statement in FY 01.

- Construction in the underground Exploratory Studies Facility progressed significantly in 1999.

- It is expected that, in the year 2000, the Yucca Mountain project activities will transition from scientific investigations to data synthesis, model validation, repository and waste package design, and safety analysis.

- The U.S. Congress directed the DOE, through the Fiscal Year 1999 Energy and Water Appropriations Act, to evaluate the accelerator transmutation of waste (ATW) and, by the end of the Fiscal Year 1999, to prepare a roadmap for development of this technology.

- As of the beginning of FY 2000, cleanup under the DOE Environmental Management (EM) programme had been completed at 69 out of 113 sites, leaving 44 to be completed.

- NRC published for public comment a proposed regulation for disposal of high-level radioactive waste in a proposed geologic repository at Yucca Mountain, Nevada. NRC's standard is consistent with recommendations of the National Academy of Sciences and with national and international recommendations for radiation protection standards.

- NRC staff has continued development of a Total Performance Assessment Code for use in assessing performance of Yucca Mountain.

- In 1999, the Environmental Protection Agency proposed the site-specific environmental standards for Yucca Mountain, Nevada, as 40 CFR Part 197, opened a public comment period, and held public hearings in four locations.

COUNTRY FOCUS

THE NETHERLANDS

1. The institutional framework

1.1 Legislation

All activities relative to the import, transport, use, storage, disposal and export of radioactive material are subject to the provisions of the *Nuclear Energy Act* (1963, last revised 1994)[1]. This includes the construction and operation of nuclear power stations but also of other nuclear facilities such as radioactive waste disposal facilities. The Nuclear Energy Act is a framework act, which is enacted by separate decrees and ordinances, which aim to implement specific parts of the act.

In the legislation a fundamental distinction has been made between activities related to the nuclear fuel cycle, which follow the most stringent regime, and activities related to the application of radioactive sources and electrical appliances emitting X-rays. The decrees with the most direct bearing on radioactive waste management are: the *Nuclear Installations, Fissionable Material and Ores Decree* (1969, last revised 1994), the *Radiation Protection Decree* (1986, last revised 1994) and the *Decree on the appointment of the Central Organisation of Radioactive Waste (COVRA) as recognised waste management organisation* (1987).

Both promotion and protection aspects of nuclear energy are combined under the same act. The Nuclear Energy Act also designates the various competent authorities and outlines their responsibilities.

1.2 The regulatory body

The Regulatory body for radioactive waste management coincides with other regulatory functions regarding implementation and enforcement of the Nuclear Energy Act. Several Ministries are involved, each for its specific area of responsibility. That means that regulatory responsibility is divided between different organisations. The most involved ministries are the following:

- *Ministry of Housing, Spatial Planning and the Environment*, for protection of the general public and the environment.

1. Nuclear Energy Act, Bulletin of Acts Orders and Decrees, 82, 1963 as revised 1994.

- *Ministry of Economic Affairs*, with the responsibility to ensure the undisturbed supply of electricity to the public and for physical protection and safeguards.
- *Ministry of Labour and Employment*, for protection of the workers exposed to radiation from practices involving radioactive materials.
- *Ministry of Health, Welfare and Sport* for protection of the patient undergoing medical examination and treatment.
- *Ministry of the Interior*, for emergency response to large-scale accidents involving radioactive material.

As regards radioactive waste management, much emphasis is placed on aspects associated with protection of the population at large and the environment and, consequently, the Ministry of Housing, Spatial Planning and the Environment has a leading position in this area.

Licensing

The Nuclear Energy Act requires a license issued by the Regulatory Body for all activities involving radioactive materials, fissionable materials and ores when they exceed certain pre-set exemption levels. These activities include import, export, transport, preparation, use, storage, release and disposal of materials and construction and operation of facilities. With the objective to achieve a complete separation between promotion and protection aspects of nuclear energy applications, the prime responsibility with respect to licensing has recently been assigned to the Ministry of Housing, Spatial Planning and the Environment for all licenses.

In a revision of the Nuclear Energy Act, which is yet to be implemented, decommissioning of nuclear installations will also become an activity for which a license is required.

In parallel to the Nuclear Energy Act, there are two other acts which have a bearing on the possibility of acquiring or modifying a license:

- The **Environmental Protection Act,** which stipulates that an Environmental Impact Assessment should be presented if an application for a license or, in certain cases, a modification of a license is made.
- The **General Administrative Law Act,** which sets out the procedures for obtaining a license including the specification of maximum terms for each decision step in the process and lays down the rights of the public to raise objections and appeals to a license.

Regulatory inspections and enforcement

Article 58 of the Nuclear Energy Act states that the ministers who are responsible for licensing should entrust designated officials with the task of supervising inspection and enforcement. The main bodies for inspection and enforcement are the Nuclear Safety Division – as of 1 July 2000 transferred from the Ministry of Social Affairs and Employment to the Ministry of Housing, Spatial Planning and the Environment as result of a Government decision to concentrate regulatory functions on radiation protection and nuclear safety in a single organisation – and the Environment Inspectorate of the same ministry.

The Nuclear Security and Safeguards Section of the Ministry of Economic Affairs remains responsible for physical protection of nuclear installations and for safeguards of nuclear material.

1.3 The waste management agency (COVRA)

In the Netherlands, the use of radioactive materials is permitted only if licensed under the Nuclear Energy Act. This act stipulates that a licensee can dispose of waste only if disposal is specifically approved in a license or by handing it over to the authorised waste management organisation. As such, COVRA is the only organisation authorised by the Government of the Netherlands.

COVRA became operational in 1984, and its legal tasks are removal, treatment and storage of all categories of radioactive waste generated in the Netherlands. Storage is conceived to take place on one single location, for a period of at least 100 years.

COVRA is responsible for the treatment and storage of all kinds of radioactive waste. Some 90% of COVRA's shares are held by the main waste producers, which are the nuclear facilities at Dodewaard (30%), and Borsele (30%), as well as the Energy Research Foundation (30%) at Petten. The remaining 10% are held by the State, where the Ministry of Public Housing, Spatial Planning and Environment acts as the State's representative. Decisions which are of concern to the shareholders must be agreed unanimously, which means that every shareholder, including the State, has the right to veto any decision.

Due to the future discontinuation of the use of nuclear energy for electricity production, plans to change the ownership of COVRA into a State-owned company are in an advanced stage.

1.4 International agreements

The Netherlands has signed (1999) and ratified (26 April 2000) the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management.

2. Policies and strategies

2.1 Waste management

The Dutch policy in this field is based on a report on radioactive waste which was presented by the Government to parliament in 1984. This report covered two basic areas: the first concerned the long-term interim storage of all radioactive wastes generated in the Netherlands, the second had a bearing on the Government's research strategy regarding the possibilities for final disposal of these wastes.

Investigations in the first area led to the establishment of the Central Organisation for Radioactive Waste (COVRA) in Borsele, whereas in the second one they led to the establishment of a research programme on the disposal of radioactive waste. Pending the outcome of the results of the research programme and the assurance of adequate political and public acceptance, it was decided that an engineered surface storage facility be constructed with sufficient capacity to accommodate all radioactive wastes generated in a period of at least 100 years.

Although the research programme was completed in 1993 with the conclusion that from a safety point of view there are no prohibitive factors which would prevent the deep underground disposal of radioactive waste in salt, the public acceptability of underground waste disposal remained low. Progress of the disposal programme for radioactive waste stalled, because no approval could be obtained for site investigations in salt formations which were, in principle, considered suitable for this purpose. The perspectives for construction of a waste disposal facility within the next decades are consequently remote.

In 1994 the Government adopted a position paper on the feasibility and the acceptability of deep underground disposal of highly toxic and radioactive waste. This paper can be summarised as follows:

- In principle, the generation of highly toxic waste is undesirable from the point of view of sustainable development (integrated life-cycle management). The flow of highly toxic wastes should therefore be minimal, through the optimal use of prevention and recycling activities.
- Long-term disposal must be arranged for existing waste and for future waste if arising of this waste cannot be prevented. The disposal facility should be constructed in such a way that the waste is not only retrievable but that in principle the whole disposal process can be reversed. This requirement is imposed firstly with the aim to maintain control over the waste and secondly to ensure that the waste remains accessible for purposes of re-entering it into the cycle when such an opportunity arises provided that this can be done in an environmentally responsible manner.
- While recognising that salt formations in the deep underground provide a good natural isolation of the waste, a disposal method which excludes the possibility of retrieval is not in line with this policy and is therefore rejected.
- Further research focusing on retrievable disposal methods is to be carried out, preferably in an international framework.

2.2 Organisational and financial aspects of radioactive waste management

Organisational aspects

The situation with respect to electricity production within the countries of the European Union is rapidly changing. Directive 96/92/EC, concerning common rules of the internal market in electricity, introduced competition in the construction of new electricity generating capacity by a tendering or an authorisation procedure. The Netherlands has implemented this EC Directive by a revision of the Electricity Act which entered into force on 1st of August 1998. The liberalisation of the electricity market in combination with the dim perspectives for nuclear energy prompted the electricity generating companies to negotiate the conditions under which they could retreat as shareholders in COVRA. Since COVRA as the recognised radioactive waste management agency is considered to have a public utility function, it is envisaged that all the shares in COVRA will be transferred to the State. The deliberations on this issue are ongoing, but it is expected that an agreement could be reached by the end of 2000.

It is recommended by the advisory committee on the stranded costs in the electricity production sector that after the transformation of COVRA into a State-owned agency a merger

between GKN, the operator of decommissioned nuclear power station at Dodewaard and COVRA, should be implemented. Preliminary talks have demonstrated a mutual benefit from such a merger because, on one hand, the technical expertise in the field of design and operation of the reactor installations would be maintained, while on the other hand expertise on radioactive waste handling techniques is assured. It is envisaged that the joint venture between the two companies could be realised as soon as the financial obligations for the long-term management of the radioactive waste from the Dodewaard power station have been settled. This is scheduled for the first semester of 2001.

Financial aspects

One of the basic principles governing radioactive waste management and also adhered to in the Netherlands is the polluter pays principle. This principle requires that all costs associated with radioactive waste management are borne by the persons or institutes responsible for the generation of this waste. These costs, which include costs for removal, transport, treatment, conditioning, storage and disposal are charged by COVRA to its customers. According to its statutes COVRA is set up as a non-profit organisation which works on the basis of full cost recovery. In that respect COVRA is in practice a monopolist, because it is the only recognised radioactive waste management agency. On the other hand COVRA has a legal obligation to accept the waste offered by license holders for removal provided that it meets the acceptance criteria, as set by COVRA.

For LILW there are fixed tariffs for specified categories of radioactive waste which take into account all management costs as explained before. Once the transfer of the waste has been accomplished the customer is exempted from further liability for the waste. No surcharges can be made to make up for exploitation losses by COVRA and no waste can be returned to the customers. While the tariffs are annually adjusted with the price index, every five years the tariff structure is evaluated with the aim to reconsider the need for any structural adjustment. However, the utmost restraint is exercised to any proposal for an increase of the tariffs, in order to prevent the temptation of environmentally irresponsible behaviour with the waste by the customer. In the previous period COVRA suffered substantial and structural exploitation losses for the management of LILW which can be partly attributed to a successful implementation of national waste separation and reduction policies. Financial support as a combination of a subsidy and a loan was granted by the government, aimed to ensure that COVRA will have a positive financial result for the next 15 years.

While it is recognised that COVRA as a waste management agency has a public utility function, negotiations with the electricity sector on the transferral of shares focus on a fair share of all parties concerned in the future losses of COVRA.

The management costs for HLW are dealt with in a different way. HLW is presently generated by essentially 5 customers, namely the two nuclear power stations (Borsele and Dodewaard) and two research reactors (JRC in Petten and IRI in Delft) and one institute for nuclear energy research (ECN).

These 5 customers have joined forces and concluded an agreement for the construction of a long-term interim storage facility for HLW, the HABOG. This agreement includes a break-down of the costs associated with construction (1999-2003) as well as with maintenance of the HABOG both

during its active phase of operation (2003-2015) and during its passive phase of operation (2015-2130[2]).

The cost break-down for these customers is:

EPZ (operator of the Borsele NPP):	61.6 %
GKN (operator of the Dodewaard NPP):	15.9 %
JRC (research reactor):	12.4 %
ECN (research institute):	8.6 %
IRI (research reactor):	1.5 %

The total construction cost for the HABOG is estimated at Hfl. 255 million (1999 price level).

As mentioned before, three of these main customers (EPZ, GKN and ECN) are also shareholders in COVRA and have expressed their intention to step down as shareholders and to be exempted from each liability for the waste in the future. The negotiations concentrate on the establishment of financial provisions which are adequate for covering the long term management of radioactive waste and for minimising financial risks of COVRA.

For the realisation of an underground disposal facility which is designed for the disposal of both LILW and HLW, a total amount of about Hfl. 2.7 billion is estimated (1985 price level). For HLW only a cost estimate of approximately Hfl.1.8 billion is utilised. Financial provisions have been made on the assumption that disposal will not occur before 2130 and annual contributions are being paid into the fund which are based on an estimated interest rate of 3.5 %.

2.3 Decommissioning

In December 1994 the Government has taken the political decision to phase out of nuclear energy by 2003 by announcing the closure of the two nuclear power stations at the end of that year. In 1996, the electricity generating board decided to take the Dodewaard plant out of operation due to lack of perspective for nuclear energy. As a follow-up of that decision, a decommissioning plan was submitted to the regulatory body which envisaged to bring the plant in a condition of safe enclosure. Consequently, a clear choice for a postponed dismantling option was expressed. Dismantling would commence after a cool-down period of about 40 years.

Since the Government had a slight preference for direct dismantling, two separate in-depth studies were commissioned to aid the decision-making process: one focusing on the radiation protection aspects, the other one addressing the financial aspects of the three decommissioning options considered. These options involved:

i) rapid decommissioning within a period of ten years;
ii) postponed decommissioning within 50 years;
iii) "*in situ*" decommissioning.

The studies can be briefly summarised in the statement that comparison of the three options considered led to results which are not discriminating with respect to radiation protection and other safety aspects, but which strongly favour the postponed dismantling option because of financial benefits which increase with time.

2. The storage period ends with the disposal of the waste; for cost discount purposes the year 2130 is utilised.

In May 2000 the Government decided that they would not oppose postponed dismantling. The three options are described in more detail in the Environmental Impact Assessment for the decommissioning of the Dodewaard plant which has been launched shortly as part of the license application for bringing the reactor building in a safe enclosure.

It is expected that for the same reasons postponed decommissioning will be the preferred option for the nuclear power station in Borsele after its scheduled shut-down in 2003.

3. Waste sources, types and quantities

3.1 Low- and intermediate-level waste

In the Netherlands radioactive waste originates from two nuclear power stations: a 450 Mwe plant in Borssele (in operation) and a 55 MWe plant in Dodewaard (closed-down in 1997), from two research reactors (in Petten and Delft), the uranium enrichment facility in Almelo and about 200 users of radioactive materials and sources, including research institutions, hospitals and industries.

At present, only low and intermediate-level radioactive waste (LILW) has been collected, processed, conditioned and stored. (See section 4.1)

3.2 Spent fuel and high-level waste

The nuclear plant operators have opted for the reprocessing of the spent fuel arising from the nuclear power stations, and contracts with reprocessing companies have been stipulated to that end. Reprocessing has become a controversial issue and the need for it has been questioned in several debates in Parliament. This prompted the Government to commission a study on the pros and cons of reprocessing with the objective to compare two spent fuel management options (reprocessing and once-through cycle) from the standpoint of radiological impact, proliferation and costs. The conclusion of the resulting report was that the differences between the two fuel cycles examined are small for radiological protection and proliferation aspects, while the reprocessing option is preferable from cost-control considerations. This conclusion lent support to the decision of the Government to maintain its policy of reprocessing. Consequently, spent fuel from the Borsele and Dodewaard plants continues to be shipped regularly to the reprocessing facilities in France and the UK respectively. Awaiting its transferral, spent fuel from the nuclear power stations is temporarily stored in the storage ponds at the reactor sites. In due time after reprocessing the resulting high level waste (HLW) will be returned in a vitrified form in accordance with the contracts.

3.3 Very low-level waste

Relatively large volumes of very low level radioactive waste are produced in the ore-processing industry. Generally this waste is generated in the form of a relatively stable product, such as residues or slag, for which no further conditioning is needed; some 1 000 m^3 is produced annually. The construction of a dedicated storage building for this type of waste was completed in the course of 2000.

4. Storage system

4.1 Low- and intermediate-level waste

The facilities of COVRA which are in operation since 1992 include a waste processing and conditioning building comprising, amongst others, a 1 500 tons super compactor for solid wastes, incinerators for animal carcasses and liquid organic wastes, a scrapping installation, a grouting installation, and a water treatment installation.

For the storage of LILW a separate prefabricated storage building was constructed. In December 1999 a total of about 25 000 waste packages (~7 000 m^3) of conditioned waste was held in storage. This amount increases annually with about 200 m^3 of conditioned waste.

4.2 Spent fuel and high-level waste

It is envisaged that HLW be stored in a dedicated engineered facility, the HABOG, which is now under construction at the COVRA site. The HABOG is separated in two compartments: one for waste which requires cooling, e.g. the vitrified fission products, and one for waste for which such requirement does not exist. The compartment for the storage of HLW is of a vault type design, in which the waste canisters are placed in a closed system filled with an inert gas to prevent corrosion. This sealed enclosure is designed to be cooled in its entirety by natural convection of air. The HABOG will also accommodate some or all of the spent fuel from the research reactors. According to the most recent planning the HABOG will come into operation in 2003.

5. Waste disposal

The publication of the position paper by the Government in 1993 effected a reorientation of the focus in the studies on radioactive waste disposal. This resulted in the inception of the CORA research programme which actually set off in 1996. The main characteristics of this programme are outlined below:

- The scope of the research was broadened to cover several retrievable disposal options including consideration of other relevant host rock materials than salt; particularly sedimentary clay formations were taken into account; also extended storage at the present location, aimed to cover a period of 300 years, was studied;
- The feasibility of construction of a retrievable repository in different host rock materials and time-dependence of the structural requirements was analysed;
- The impact of the principle of retrievability of radioactive waste on repository design, on safety and on the costs of a repository was investigated;
- Additional investment costs and maintenance costs of retrievable repositories in different host rocks were considered;
- The consequences of direct disposal of spent fuel in a geological repository was included in the programme;
- The social and ethical aspects of a retrievable disposal facility were taken into account;

- Studies to the effect of reduction of the radiotoxicity of the radioactive waste by partitioning and transmutation of the actinides and long-lived fission products were undertaken.

The CORA research programme is due to be completed with the publication of the main report by the end of 2000. Some preliminary conclusions from individual studies can be drawn already:

- All retrievable repository options studied are technically feasible.
- The radiological consequences after failure of the containment during the period in which accessibility of the emplaced radioactive waste is maintained for purposes of retrieval, are three orders of magnitude higher for clay as compared with salt.
- Both underground repositories perform better than extended long term storage in a situation of neglect, due to loss of human control.

On the basis of the results and recommendations of the final CORA report, a research programme on radioactive waste disposal will be established for the next period.

NATIONAL PROGRAMMES AND POLICIES

AUSTRALIA

1. National near-surface repository

The Government is currently progressing the study to identify a suitable site for a national radioactive waste repository for the near-surface disposal of Australia's low level and short-lived intermediate level radioactive waste.

The study to find a suitable site began in 1992. The whole of Australia was assessed, using a geographical information system, against thirteen criteria set out in the National Health and Medical Research Council's Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia (1992). Site selection criteria emphasise factors such as suitable geology, hydrogeology, remoteness from population centres and arid climate. The Code was developed from IAEA standards.

In February 1998, the Government announced that site selection studies for the repository would be undertaken in the central-north region of South Australia, which covers an area of some 67 000 square kilometres, on the basis that this region contained the largest area considered to be suitable against the selection criteria as compared to the other seven regions identified in the earlier phase of the study.

Investigative drilling commenced in 1999 and a preferred site is expected to be selected in late 2000. The selection of the preferred site will be followed by environmental impact assessment and licencing by the Australian Radiation Protection and Nuclear Safety Agency. Should all approval processes be met, it is anticipated that construction of the near-surface repository could begin in the year 2002, with operation commencing in early 2003.

Less than 3 500 cubic metres of low and short-lived intermediate level waste, arising from medical, industrial and research use of radionuclides, is stored at some 50 sites around Australia. Wastes include lightly contaminated soil, plastic, paper, protective clothing, gauges and electron tubes. Interim storage arrangements are unlikely to pose a health hazard but have caused public apprehension in some areas and Government agencies have had difficulties making alternative arrangements.

A community consultation programme has been developed to allow for stakeholders to obtain information about the project and comment on the proposal. State and Regional Consultative Committees will allow for ongoing discussions with the community. The programme also includes the production and distribution of an information kit, discussion papers, Government response papers to comments received from the public and a regional newsletter.

The repository will be operated in accordance with the NHMRC Code of Practice referred to above.

2. National store for long-lived intermediate level waste

A process for selecting a site for a national above-ground storage facility for the management of Australia's small quantity of long-lived intermediate level waste will be a separate process form the site selection for the national repository.

The search for a site for the store will commence during 2000, and an indicative timeframe for the process would be the identification of a preferred site during 2002, with construction in 2005 after an environmental impact assessment and licensing have been completed.

Australia has a total of 500 cubic metres of long-lived intermediate level waste. Long-lived intermediate level wastes to be held in a national store include obsolete medical radium sources, sealed industrial radioactive sources, irradiated components from research reactor operations and wastes returned from overseas treatment of spent fuel from ANSTO's HIFAR research reactor (expected from 2015 onwards) and the replacement research reactor.

The long-lived intermediate level wastes would be stored at a national store until a deep geological disposal facility is available or necessary. Establishment of any final disposal facility for long-lived intermediate level radioactive waste in the future would be the subject of a separate site selection study.

3. International waste repository in Australia

Successive Australian Governments have agreed that Australia should not accept the radioactive wastes of other countries.

Pangea Resources approached the Australian Government seeking support for its proposal for an international deep geological disposal facility for the world's high level radioactive waste. The Government has written to Pangea advising that the Government's policy prohibiting the importation and disposal of other countries' radioactive waste is absolute and will not be changed.

4. HIFAR spent fuel

On 3 September 1997 the Government announced its decision to establish a replacement research reactor at Lucas Heights, to be commissioned in 2005. The government also announced that it had decided against establishing a domestic spent fuel reprocessing facility.

A total of 689 U.S.-origin spent fuel rods will be repatriated to the U.S., with no waste to be returned to Australia. Of that number, 240 rods were repatriated in 1998.

The balance of 1 300 rods is of non-US origin, and will be shipped to La Hague in France for reprocessing. Reprocessing is expected to yield around six cubic metres of cemented long-lived intermediate level waste, which will be returned to Australia in certified transport and storage casks by 2015. This material will be handled along with other Category S wastes. Australia already holds waste of this type in secure storage, including obsolete industrial and medical radiation sources and radium

gauges. Storage arrangements for intermediate level wastes will be finalised well before return of wastes of this level from overseas. A similar strategy will be adopted for management of radioactive wastes from the replacement reactor.

5. Research and development of titanate ceramic waste forms

The development of ceramic waste forms for the immobilisation of high-level and long-lived radioactive waste is continuing. In particular, ANSTO is continuing to collaborate with Lawrence Livermore National Laboratory on the development of a ceramic waste form for the immobilisation of surplus weapons plutonium. A ceramic waste form is also being assessed for the immobilisation of the wastes arising from the production of molybdenum-99 at the ANSTO site.

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BELGIUM

1. Regulatory developments

After the parliamentary elections of 13 June 1999, the new Belgian federal government was installed on 14 July 1999. Under this government, the Secretary of State for the Energy acts as general supervising authority of ONDRAF/NIRAS, while the Minister of the Interior acts as supervising authority for the nuclear safety aspects, and the Minister of Employment as supervising authority as far as the technical safety of the nuclear facilities is concerned. The Minister of the Interior is also the supervising authority of the Federal agency for nuclear control that was created in 1996 and is in the process of becoming operational.

2. Radwaste processing and conditioning

The general rules for the establishment of acceptance criteria for non-conditioned and conditioned waste were approved by the competent authorities and have been implemented since 10 February 1999. The technical and administrative terms of acceptance were established. They define the general principles for the acceptance of both non-conditioned and conditioned radioactive waste by ONDRAF/NIRAS.

The project with regard to the treatment of the so-called HRA/SOLARIUM waste progressed well as far as the preparation and the construction of the building for the sorting of the waste is concerned. This building will also be designed for the covering of the HRA pits.

The project with regard to the alpha-waste saw the development of the concept of a facility for the treatment and the storage of the waste concerned.

3. Storage of radioactive waste

In view of the return of conditioned vitrified waste resulting from the reprocessing in France (Cogéma) of Belgian spent fuel, several transfer tests with the transport canisters took place both at the transfer railway station in Mol and in the interim storage building on the site of Belgoprocess.

By the end of the year, the federal government decided the first repatriation transports of the waste concerned should take place from 2000 onwards. To that end Synatom, who is in charge of the Belgian fuel cycle, took the necessary steps to obtain the transport authorisations on the Belgian territory.

4. Disposal of conditioned radioactive waste

4.1 Near surface disposal of low-level and short-lived radioactive waste

As part of the disposal action programme for the period 1998-2001 that was developed following the decision of the Belgian Federal government with regard to the long-term management of low-level and short-lived radioactive waste, ONDRAF/NIRAS has concentrated its research on the existing nuclear sites and the development of local partnerships. A local partnership is meant to involve the various local actors in the development of all the activities that are expected to result in a disposal project proposition that can be integrated in a more global project with positive effects for the zone or region considered and can be accepted by the population of that zone or region. The partnership gathers representatives of all the political parties, the various economic, social, cultural and ecological actors, as well as the local industry. It is structured around a general assembly, a management committee, the project coordination that manages the partnership's activities on a day-to-day basis, and working groups who will have to work out the actual project proposals. The partnership has its own budgetary means provided for by ONDRAF/NIRAS, so that it can function on an independent basis.

By the end of 1999, situation was as follows: on 30 September 1999, a first partnership was signed between ONDRAF/NIRAS and the local authorities of Dessel (on whose territory the centralised interim storage buildings of conditioned waste are located). The general assembly has been installed and the partnership has been located in the old town hall of Dessel that has been equipped to act at the same time as a central meeting place where the inhabitants can get the necessary information or answers to their questions. Negotiations with the local authorities of Mol (where the national nuclear research centre SCK•CEN is located) progressed well and allowed to establish a local partnership begin February 2000. In the meantime, the general assembly of the Mol local partnership has also been established. The authorities of the zone of Fleurus-Farciennes (where the national Institute for Radio-Elements – IRE – is located) confirmed their interest but decided to let their final agreement depend on the results of preliminary soil examinations on the site of the IRE that started in August 1999 and would probably be completed at the beginning of the year 2000. The authorities of the municipality of Huy (on whose territory the nuclear power plant of Tihange is located) showed no interest, while the authorities of the municipality of Beveren (on whose territory the nuclear power plant of Doel is located) did not yet decide whether and when they will start negotiations with ONDRAF/NIRAS.

4.2. Deep underground disposal of high-level and long-lived waste in clay

Research with regard to underground disposal in deep clay layers of high-level and long-lived radioactive waste (vitrified reprocessing waste and/or spent fuel) is covered by the 1998-2003 research programme that was signed in 1998 by the parties involved. Important progress was made with the development of the infrastructure necessary for the realisation of the PRACLAY-demonstration programme. The extension of the existing HADES underground research laboratory in the Boom clay on the nuclear site of SCK•CEN in Mol saw the excavation and the lining of a second shaft up to -230 meters. The lift equipment with two cages was placed in September 1999. Besides, the starting chamber from which the gallery, that will connect the second shaft with the existing HADES underground laboratory, will be excavated was made ready.

5. Miscellaneous

From 11 to 13 October 1999, Belgium hosted the ENS Topseal conference '99 in Antwerp. The issue of the conference was "Commitment to the future environment". ONDRAF/NIRAS was in charge of the practical organisation of the conference.

The CD-ROM on radioactive waste management in the countries of the European Union, which was realised under the coordination of ONDRAF/NIRAS and is co-sponsored by the European Commission, was made available in its English version. Its large scale diffusion is a matter of decision by the European Commission.

The Ampère commission that was set up by the Minister in charge of the Energy policy to formulate recommendations with regard to Belgium's energy future, continued its activities and started with the first preparations of its report to the federal government.

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CANADA

1. National regulation

The Nuclear Safety and Control Act, replacing the existing Atomic Energy Control Act of 1946, received Royal Assent in March 1997. It is expected that it will be proclaimed in mid-2000, after the new regulations pursuant to the Act have been approved.

The Nuclear Liability Act (NLA) establishes the legal regime that would apply in the event of a Canadian nuclear accident affecting third parties. The NLA is modelled closely after the Vienna and Paris conventions. Natural Resources Canada is conducting a comprehensive review of the legislation. The review is almost complete and is being influenced by recent revisions to the Vienna Convention.

On May 31, 2000 the AECB officially became the Canadian Nuclear Safety Commission (CNSC).

2. Uranium industry

Despite a continuation of the poor market conditions that led to mine closures and production cutbacks in many uranium producing countries in the second half of 1998, the transition to new, high-grade uranium production centres continued in Canada. Production at the new McClean Lake mill began in July 1999, modifications to the Key Lake mill were completed by November 1999, and the McArthur River mine began production in December 1999. All McArthur River ore will be milled at the upgraded Key Lake facility. Test mining and mine development continued at Cigar Lake, with the mine currently scheduled to open in late 2002.

In August 1998 COGEMA Resources Inc. (CRI) announced plans to suspend operations indefinitely at Cluff Lake by December 31, 2000. CRI stated that the low market price could not sustain the operation in its current form, and that local reserves were insufficient to support the creation of the new tailings management facility that would be required in 2001. CRI is currently preparing a comprehensive study environmental assessment of its plan to suspend operations at Cluff Lake.

In November 1998, Cameco announced plans to mill a portion of the Cigar Lake ore at Rabbit Lake (originally all Cigar Lake ore was to be milled at McClean Lake). This new milling plan could extend the life of the Rabbit Lake mill, which was originally destined to close early in the next decade, by some 15 years. Cameco is currently preparing a comprehensive study environmental assessment of this new milling plan.

In April 1999, Cameco and CRI purchased KEPCO's (Korea Electric Power Corp.) 2% non-voting interests in the Cigar Lake uranium joint venture for an undisclosed price. In May 1999, Cameco sold interests in selected uranium assets in Saskatchewan (17% of the Key Lake mill, 14% of the McArthur River mine and, subject to rights of first refusal, 20% of the Midwest mine) to CRI, for a total of approximately $250 million. In August 1999, Denison Mines Ltd. exercised its right of first refusal and purchased an additional 5.17% interest in the Midwest property for an undisclosed price.

3. Nuclear power programme

Nuclear Power Data*

	Canada	Ontario	New Brunswick	Québec
Electricity Demand Growth (% p.a.)	0.4	1.1	0.7	–3.8
Nuclear Share (%) of Electric Utility Generation	13.4	43.8	21.1	2.8
Reactors in Service	14	12	1	1
Capacity In Service (Net MWe)	10301	9028	635	638

*As of December 31, 1998.

Note: Bruce 1,2,3,4 were taken out of service indefinitely on 16 October 1997, 8 October 1995, 9 April 1998 and 17 March 1998 respectively. Pickering 1,2,3,4 were taken out of service indefinitely at the end of 1997.

Status of the Canadian Nuclear Power Programme

Ontario

On April 1st, 1999, Ontario Hydro, once North America's largest power company, officially ceased to exist. The provincially owned electricity giant, established in 1906, was split up into five separate entities under a provincial restructuring plan. The two largest of the successor companies are Ontario Power Generation Inc. (OPG), the entity that will run the province's 80 generating stations, and Ontario Hydro Services Co., which will run the province's 29 000 kilometre transmission network and supply electricity to about one million customers, mostly in rural Ontario. To enhance competition, the province has adopted rules that will break the generation company's near monopoly of the power market.

New Brunswick

The New Brunswick government is also reviewing the future structure of the electricity market and the future role of NB Power. A study on Point Lepreau by Hagler, Bailly, a consulting firm commissioned by NB Power, concluded that the reactor could not be expected to be operated beyond 2008 without substantial new investment. The decision NB Power and the government must make regarding investing to extend the life of Point Lepreau beyond 2008 will involve a comparison between the total costs of electricity production at Point Lepreau and the total cost at an alternative facility. There is also the issue of whether Point Lepreau will be privatised along with NB Power's conventional generation facilities if the decision is made to privatise NB Power. At this point in time the economics look favourable for Point Lepreau.

Québec

Québec has a single CANDU 6 unit in operation at Gentilly. It is anticipated that the unit will operate until the 2010-2015 time-frame if no decision is made to extend the life of the unit.

4. Organisation of nuclear R&D

Whiteshell Laboratories

On December 16, 1998 Atomic Energy of Canada Limited (AECL) announced that it was terminating nuclear research activities at Whiteshell Laboratories by December 2001.

Two key scientific research programmes, the Reactor Safety Research Programme and the Nuclear Fuel Waste Management Programme at the Underground Research Laboratory will continue in the Pinawa and Lac du Bonnet area. The Reactor Safety Research Programme will continue to operate out of Whiteshell until December 2001, when the programme will be consolidated at AECL's facilities at Chalk River and Sheridan Park, Ontario. The world-class research being undertaken on the Nuclear Fuel Waste Management Programme at Lac du Bonnet will be privatised, following consultation with key stakeholders.

Canadian Neutron Facility

The federal government is presently considering the proposal by the National Research Council and AECL for the Canadian Neutron Facility which would replace the NRU facility which is nearing the end of its life.

5. Radioactive waste management

5.1 Policy framework for radioactive waste

In 1996, the Government of Canada established its Policy Framework for Radioactive Waste, which covers all forms of radioactive waste including nuclear fuel waste, low-level radioactive waste and uranium mine and mill tailings. The Policy Framework, developed in consultation with a broad range of stakeholders, states that:

- The federal government will ensure that radioactive waste disposal is carried out in a safe, environmentally-sound, comprehensive, cost-effective and integrated manner;
- The federal government has the responsibility to develop policy, to regulate, and to oversee waste producers and owners for ensuring that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved disposal plans; and,
- The waste producers and owners are responsible, in accordance with the principle of “polluter pays”, for the funding, organisation, management and operation of disposal and other facilities required for their wastes. This recognises that arrangements may be different for nuclear fuel waste, low-level radioactive waste and uranium mine and mill tailings.

The Framework therefore lays out the ground rules and sets the stage for the further development of institutional and financial arrangements to implement disposal of radioactive waste in a safe, environmentally sound, comprehensive, cost-effective and integrated manner. The Framework highlights that the federal government has the responsibility to develop policy, to regulate, and to oversee radioactive waste producers and owners in order that they meet their operational and funding responsibilities in accordance with approved disposal plans.

5.2 Nuclear fuel waste

In 1988, the Minister of Natural Resources referred AECL's concept for deep geological disposal to the Minister of the Environment for a public review by an independent panel (which came to be known as the Seaborn Panel, named after its Chairman), pursuant to the Environmental Assessment and Review Process Guidelines Order. AECL submitted its Environmental Impact Statement to the Panel in 1994.

From March 1996 to March 1997, the Seaborn Panel held public hearings on AECL's concept of geological disposal of nuclear fuel waste deep underground in stable rock of the Canadian Shield. This concept translates into a major undertaking which would cost about $10-13 billion over up to 70-100 years. The Panel reported its conclusions and recommendations to the Government on March 13, 1998:

- the Panel's main conclusion was that although, on balance, the disposal concept was found to be technically safe, it was not demonstrated to have broad public support; and,

- the Panel's principal recommendation was that a separate arm's-length government agency be created to manage Canada's next nuclear fuel waste management activities which would be fully funded by waste producers and owners and subject to multiple federal oversight mechanisms.

On December 3, 1998, the Government of Canada announced its response to the Panel's report. In its response, the Government of Canada made clear that it expects that:

1. The producers and owners of waste will establish a waste management organisation, incorporated as a separate legal entity, with a mandate to manage and co-ordinate the full range of activities relating to the long-term management, including disposal, of nuclear fuel waste. The waste management organisation will:
    - have a Board of Directors, representative of producers and owners of nuclear fuel waste;
    - have an advisory council;
    - be comprehensive, i.e., allow for the participation of all producers and owners of nuclear fuel waste.
2. The producers and owners of nuclear fuel waste in Canada will establish a fund to fully finance all activities and operations of the waste management organisation including the costs for developing and comparing waste management options, for designing and siting the preferred approach for the long-term management, including disposal, of nuclear fuel waste, for implementation, and ultimately for decommissioning waste management facilities.
3. The waste management organisation will report to the Government setting out its preferred approach for the long-term management, including disposal, of nuclear fuel waste, with justification, as well as:
    - a comprehensive public participation programme;
    - an ethical and social assessment framework;
    - an Aboriginal participation process;
    - practicable long-term waste management options from Canada, including the following: a modified AECL concept for deep geological disposal; storage at reactor sites; and centralised storage, either above and or below ground;
    - a comparison of risks, costs and benefits of the options along with proposed siting territories; and,
    - future steps.

The Government of Canada will determine whether it accepts the report and the preferred approach proposed by the waste management organisation.

The Government of Canada also announced its three key policy objectives consistent with the 1996 Radioactive Waste Policy Framework for proceeding with the next steps on the long-term management, including disposal, of nuclear fuel waste:

- to establish a dedicated fund to be paid by waste producers and owners for financing fully the long-term management, including disposal, of nuclear fuel waste;
- to establish a reporting relationship between the federal government and a waste management organisation, for reviewing progress on a regular basis; and
- to establish a federal review and approval process to exercise federal oversight and to provide access to the dedicated fund.

Ministers agreed that the Minister of Natural Resources initiate a consultative process to develop options on oversight implementation mechanisms, including legislative mechanisms, to meet the three objectives, and return to Cabinet with the preferred option. Consultations with stakeholders, including waste producers and owners and the public, took place in early 1999. The Minister of Natural Resources is assessing the consultation results and expects to submit recommendations on how best to implement the needed federal oversight to the Government in the near future.

5.3 Low-level radioactive waste

In Canada, low-level radioactive waste is either produced on an on-going basis or is classified as historic waste. OPG and AECL are the two largest producers of on-going low-level radioactive waste. Historic waste is waste for which no private producer can be held responsible or for which the federal government has assumed the responsibility.

5.3.1 On-going wastes

Ontario Power Generation (OPG) produces about 70% of the annual volume of low-level radioactive waste in Canada. To date there has been no pressing need in OPG for early disposal; volumes are small and the waste is being safely stored on an interim basis. However, in its 1992 plan for these wastes, the utility fully recognised that, in the longer term, disposal is a necessary step in responsible waste management, so that future generations are not burdened with managing this waste. OPG has completed conceptual engineering studies and costed out options for a low-level radioactive waste disposal facility. The year 2015 is considered an achievable target date for bringing a disposal facility into service.

The other major producer of on-going low-level radioactive waste, AECL, had discussions with the AECB to license a prototype below-ground concrete vault known as IRUS (Intrusion-Resistant Underground Structure) for relatively short-lived waste. The future application of IRUS technology is currently being reassessed by AECL. Until this, or another disposal facility is available, AECL will continue to store its on-going LLW in in-ground and above-ground structures.

5.3.2 Historic wastes and the low-level radioactive waste management office

A large proportion of the existing inventory of low-level radioactive wastes in Canada consists of ‘historic wastes’. In the past year, the Low-Level Radioactive Waste Management Office continued its clean-up and monitoring initiatives at the major historic waste areas. These include Port Hope in Ontario, Surrey in British Columbia, northern Alberta, and the Northwest Territories.

Port Hope area wastes

The bulk of Canada's historic low-level radioactive wastes are located in and around the southern Ontario community of Port Hope. These wastes relate to the long-term operation of a radium and uranium refinery in the community. The federal government has for some time been examining options for the long-term management of these wastes. A siting task force established by the government in 1988 identified a community that was willing to host a disposal facility for the wastes. Subsequent negotiations between the federal government and the community failed to yield an agreement on the terms and conditions of the project.

Most recently, the three local communities where the wastes are now located have recommended to the government that the wastes be managed for the long-term locally. They have each submitted proposals to the federal government for the development of new long-term low-level radioactive waste storage facilities in their communities and the government has accepted these proposals. Negotiations are underway between the federal government and the communities on legal agreements that would define the terms and conditions under which the facilities would be developed.

Surrey wastes

Fifteen years after the federal government, through Natural Resources Canada, accepted responsibility for thorium-contaminated soil and slag at two industrial sites in Surrey, British Columbia, the Surrey Siting Task Force recommended that the material should be removed and managed at out-of-province facilities. After an environmental screening, clean up activities began in November 1999 and are expected to be completed by the end of March 2000. The licensable quantity, which constitutes a small fraction of the material, has gone to a storage facility in Ontario. The bulk of the material, which is classified as "contaminated soil" has gone to a disposal facility for hazardous waste in Oregon, United States.

Radioactive contamination in Northern Alberta and Northwest Territories (NWT)

Uranium ore was mined in the 1930s, 1940s and 1950s at Port Radium on Great Bear Lake in the NWT by the uranium mining company Eldorado. It was transported by barge to Fort McMurray in northern Alberta, where the cargo was put on rail and transported to southern Ontario for processing. Cargo spills occurred at barge transfer points.

Although the radiological impact of the contaminated sites discovered in 1991 is minimal, the federal government nevertheless decided to conduct a phased project involving clean-up activities based on sound waste disposal principles. Action has been taken annually since 1991 in the areas of site characterisation, clean-up, and monitoring activities. This project is on-going.

5.4 Uranium mine and mill tailings

In Canada, about 200 million tonnes of uranium mine and mill tailings have been generated since the mid-1950s. These comprise about two per cent of all mine and mill tailings in the country. Most of the existing uranium tailings are located in the provinces of Ontario and Saskatchewan. Decommissioning of uranium mine and mill tailings generally involves management in place, with the waste held in containment areas close to the mine sites, similar to most tailings from other mines in

Canada. There are twenty-two tailings sites, nineteen of which are no longer receiving waste material. Only the operations in Saskatchewan are now active.

With regard to financial responsibility for decommissioning and long-term maintenance of the tailings, Canada's policy stipulates that the producer pays. The AECB requires that present-day operators provide financial assurances that decommissioning of uranium mining and milling facilities will take place in a responsible and orderly manner in the short- and long-term. Where a producer or owner cannot be identified, cannot be located or is unable to pay, responsibility for decommissioning would rest with the Canadian federal and provincial governments.

In January 1996, a Memorandum of Agreement (MoA) on cost-sharing for management of abandoned uranium mine tailings was signed between the federal and Ontario governments. The Agreement recognises that present and past producers of uranium are responsible for all financial aspects of the decommissioning, and long-term maintenance of uranium mine sites, including the tailings. In the case of abandoned sites, the MoA outlines how governments will share the long-term management responsibilities and associated costs. A similar MoA covering the decommissioning and reclamation of the abandoned Gunnar and Lorado uranium mine sites is currently being developed between the federal and Saskatchewan governments.

6. Decommissioning

The AECB requires that all nuclear facilities be decommissioned in accordance with regulatory requirements. Nuclear facilities include CANDU power reactors, prototype/demonstration power reactors, research reactors, nuclear research establishments, and facilities involved in processing and fabricating uranium into fuel for power reactors or in conducting nuclear/uranium R&D activities. Planning for decommissioning activities should be initiated at the earliest stages in the design of facilities and refined during their operating life. Once the Nuclear Safety and Control Act comes into force, the Canadian Nuclear Safety Commission will have the power to require financial assurances from facility operators to demonstrate that sufficient funds will be available for the decommissioning activities.

CANDU power reactors

CANDU reactors are to be decommissioned in a staged fashion. At the end of the reactors' service life, the used fuel will be removed from the reactor core and the reactor components will be isolated and stabilised for an extended monitoring period (about 30 years after shutdown in most cases) to allow for a reduction in radioactivity by decay. The reactors and remaining structures will then be dismantled and the site restored to an acceptable state. Hydro-Québec and Ontario Power Generation are expected to complete their CANDU power reactors decommissioning activities by 2054 and 2060, respectively, while New Brunswick Power, with an extended monitoring period of 50 to 100 years, should complete activities by the turn of the next century.

Prototype/demonstration power reactors

AECL's three prototype/demonstration power reactors located at Douglas Point and Rolphton, Ontario, and Gentilly, Québec, have been shutdown and partially decommissioned with the used fuel removed and process fluids drained. The reactors have been sealed and are presently in storage with surveillance. The final stage, dismantlement or *in situ* disposal is not planned to start for several decades.

Research reactors

Seven research reactors have been operated at the AECL's two nuclear research establishments in Chalk River, Ontario, and Whiteshell, Manitoba. Two reactors remain in operation at Chalk River, two have been completely decommissioned, and the others are shut down and in various early stages of decommissioning. There is also ongoing limited decommissioning of related buildings and facilities at Chalk River. Universities with research reactors carry out limited decommissioning activities, as needed.

AECL Nuclear Research Establishments

AECL has nuclear research establishments at Chalk River, Ontario, and Pinawa, Manitoba, that are used for R&D work associated with the development of CANDU reactors, the advancement of nuclear science, and the production of radioisotopes. The nuclear research establishments, which are licensed by the AECB, include isotope production and processing facilities, fuel reprocessing facilities, waste management facilities, and miscellaneous R&D and support facilities. Some of the facilities, no longer in operation, are at various stages of decommissioning. Of particular importance, AECL has begun the planning and environmental assessment studies preparatory to decommissioning the Whiteshell Laboratories site at Pinawa. It is expected that over the next several decades, many additional facilities at Chalk River will need to be decommissioned.

Other facilities

Under the authority of the AECB, other nuclear facilities, such as uranium mine and mill facilities in Ontario and Saskatchewan, R&D facilities associated with uranium milling and processing operations, and nuclear research, fuel fabrication plants, a radioisotope production facility in Ottawa and the Laprade heavy water production plant at Gentilly have, for the most part, been decommissioned.

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THE CZECH REPUBLIC

1. Nuclear energy

The construction of the NPP Temelin is in progress, and commissioning of the first reactor unit has started:

- In February 99 the Governmental Experts Group completed the evaluation of economical aspects of the NPP Temelin completion and consequently, the Government approved the plan and the budget of the NPP completion.
- In October 99 was completed the successful testing of the main circulation pumps of the primary circuit and pressure testing of the secondary circuit of the first reactor unit.

- In February 2000 the testing of emergency systems has been completed and in beginning of March the hot non active test of primary circuit has started. The completion of the non-active testing of the first reactor unit and beginning of the loading the nuclear fuel in the reactor is planned in August 2000.

2. Regulations

In the year 1999 the State Office for Nuclear Safety has issued the new regulations:

- No. 195/1999 Coll., on Basic Design Criteria for Nuclear Installations with Respect to Nuclear Safety Radiation Protection and Emergency Preparedness.
- No. 196/1999 Coll., on Decommissioning of Nuclear Installations and Working Places with Important and Very Important Sources of Ionizing Radiation.
- No. 324/1999 Coll., on Limits of Concentration and Amount of Nuclear Material for which Nuclear Liability Requirements do not Apply.

At present time a review of the Atomic act and all connected regulations is in progress, with intention to harmonise them, and make some necessary corrections based on experience of their implementation within first two years since their issue.

3. Waste management

3.1 Repository operation

In 1999 the main activity of RAWRA has been focused on negotiations with the repositories owners on transfer of the repositories (Dukovany, Richard and Bratrstvi) into ownership of the State (represented by RAWRA) and on preparation of licensing documentation, to get licenses for operation of the repositories. Among the others there are included acceptance criteria for RW disposal, acceptance criteria for RW storage, emergency plans, monitoring programmes, limits and conditions for safe operation, etc.

In December 1999 RAWRA obtained from the State Office for Nuclear Safety licenses for management of RW and operation of repositories Dukovany and Richard. Licensing of the repository Bratrstvi is in progress. For the repositories Bratrstvi and Richard (that are underground tunnel type), RAWRA has an operational license from the Czech Mining Office, from the mining regulations point of view.

The licenses have been granted on the base of former safety assessments, therefore RAWRA shall prepare new detailed safety reports, in compliance with the new regulations. These safety and performance assessments should be completed stepwise within following 5 years.

Since January 1st, RAWRA is the owner of all three repositories in the Czech Republic, and begun their operation. Operation of the repository Dukovany is for the first phase provided by staff of the NPP Dukovany on the contractual basis. The repositories Richard and Bratrstvi RAWRA took over, together with the operational staff.

At present time RAWRA has 27 full-time employees, 4 part time employees and several activities are ensured on the contractual basis with external providers.

3.2 Waste inventory

A first phase of the waste inventory as well as waste generators has been completed. More then 400 licensees were asked for response, but only about 100 have done it. Nowadays the new registration form in electronic version is being sent to the waste generators for update. In April should begin a testing of the new database and information system on radioactive waste, that will serve as a tool for planing, communication with the generators, record keeping of disposed of or stored waste and evaluation of stored data.

3.3 Radioactive waste policy

In 1999, RAWRA prepared a proposal of the National Policy of the Czech Republic in the field of RWM and had it sent to the Ministry of Industry and Trade for comments at the end of February.

4. Spent fuel interim storage

According the regulations, the SF storage is in full responsibility of the owner of the NPPs, namely CEZ.

NPP Dukovany

The licensing of the Second Spent Fuel Interim Storage at the Dukovany site is in progress:

- In November 99, based on EIA and results of public hearings, the Ministry of Environment has agreed with the construction of the Second SF Interim Storage at the NPP site.
- In December 99 the State Office for Nuclear Safety issued the Siting License.
- In January has started the siting procedure at the regional Construction Office that gives the final approval with the site. In the case that the site approval is granted, the construction licensing procedure will started.

NPP Temelin

Preparation of SF interim storage at the site of NPP would begin after the start up of the second reactor unit.

Skalka

In the locality Skalka (in the uranium mining region Dolni Rozinka in Moravia), CEZ proposes as a reserve solution an underground (tunnel type) central interim storage for SF for both NPPs.

In December 1999, the Ministry of Environment did not agreed with the site, but despite it, in January the SONS granted to CEZ the siting license. Based on this, CEZ asked the Ministry of Environment for a revision of its decision.

5. R&D Programme

Programme of High-Level Waste Geological Repository Development

The generic conceptual design of the deep geological repository in a non-specific site has been completed, including EIA and a time schedule and budget for its realisation. As well the Siting Plan for HLW repository has been developed. Beside these some other supporting R&D studies were carried on.

Other

The project on spent ion exchange resins retrieval from the storage tanks at the NPP Dukovany, and their conditioning has been launched. The coordinator of the project is RAWRA.

A conceptual design of management system for spent sealed sources that are not acceptable for disposal in existing repositories (prevailingly Am, Pu, Am/Be, Pu/Be) has been completed. The design proposes conditioning of them and their interim storage at the Richard repository, until deep geological repository is completed. On its base, RAWRA will develop and implement the necessary equipment and procedures.

6. Decommissioning

Within the framework of long term planning there were completed also basic conceptual studies for closure of the repositories Richard and Bratrstvi. They define the expected extent of work that should be done as well a first estimation of costs of the repositories' closure.

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FINLAND[3]

1. Recent developments

1.1 Progress in spent fuel disposal programme

According to the Nuclear Energy Act, the first authorisation step towards a final repository of nuclear waste is the so-called Decision in Principle (DiP). At this step the Government shall consider whether 'the construction project is in line with the overall good of society'. In particular, the Government shall pay attention to the need of the facility, to the suitability of the proposed site and to the environmental impacts from the proposed practice.

3. Finland had been Country Focus in Nuclear Waste Bulletin N° 13.

The Radiation and Nuclear Safety Authority (STUK) has to make a preliminary safety appraisal of the DiP application and the proposed host municipality must state its acceptance or rejection for siting the facility. The decision has still to be endorsed by the Parliament.

The application for the DiP shall include an Environmental Impact Assessment (EIA) report for the planned facility. In May 1999, the organisation responsible for the preparations for spent fuel disposal, Posiva Ltd, submitted the EIA report to the contact authority, Ministry of Trade and Industry (MTI) and a DiP application to the Government.

1.2 The EIA process

The EIA report addresses all four candidate sites which have been subject to rigorous geological investigations. After the hearings in November 1999, the Ministry gave its statement, which completed the EIA process.

During the hearing period 15 authorities and public bodies, 5 civic organisations and communities and 23 municipalities submitted their statements on the EIA report to the MTI. In addition, some 15 private persons sent heir opinions.

The opinions expressed by the authorities were mainly positive and the EIA report was regarded as wide and thorough. The municipalities' attitudes towards the EIA report were also positive in most cases. One concern was the potential deterioration of the image of a municipality as a region of clean nature due to the nuclear facility in the vicinity. The anticipated impact on health rendered by the transport of spent fuel and consequent accidents were also of concern.

Private persons' and civic organisations' opinions on the EIA as well as on the whole disposal project were critical and opposing. Their viewpoints were, however, mainly focused on issues which are not dealt with on the EIA report itself

In accordance with the Espoo Convention, the EIA report was also submitted for review by our neighbouring countries. The statements by Estonia, Russia and Sweden were generally positive and expressed no concerns of potential transboundary environmental impacts from the proposed disposal facility, if the established safety requirements are complied with.

The MTI concludes in its statement that the EIA report is sufficiently comprehensive and detailed and fulfils the requirements set by the EIA legislation. The Ministry, however, points out that a construction license application for the disposal facility, scheduled to be submitted after 10 years at the earliest should include an enclosure corresponding to an updated EIA report.

1.3 The DiP process

The DiP application addresses only one site candidate, which is located in the vicinity of the Olkiluoto NPP site in the Eurajoki municipality.

STUK engaged an international review team, consisting of ten prominent scientists, to support its preliminary safety appraisal of the DiP application. The team gave their findings, included in nine "thematic" reports and in a consensus report by the whole team, to STUK in October 1999. In addition, STUK has requested for statements and expert judgements from several Finnish research institutes which have participated in the publicly funded waste management research programme.

STUK's preliminary safety appraisal was based on the safety criteria that were issued as Government Decision of March 1999. In the DiP stage, a definite position on the safety case is not yet required but rather a judgement, if the proposed concept and site are likely to provide safe disposal of spent fuel, given that prior to the construction license process, a research and development period of about ten years will be conducted, involving e.g. construction of an underground research facility at the selected site.

STUK submitted the preliminary safety appraisal to the MTI in January 2000. In STUK's appraisal, no factors were identified that would clearly indicate lack of sufficient prerequisite for implementing the disposal facility in compliance with the safety requirements. Consequently, STUK concluded that the prerequisites for a DiP are met from the standpoint of nuclear and radiation safety.

In January 2000, the council of the host municipality for disposal site, Eurajoki, gave its approval to the DiP application (votes 20 for, 7 against). The Government's decision and Parliament's ratification may be delayed due to an appeal to administrative court by a citizen of Eurajoki but are expected to take place during this year.

2. General strategy

2.1 Overall waste management strategies

In 1938, 31% of all electricity produced in Finland was generated by nuclear power. Four reactors, with a total capacity of 2 656 Mwe (net), are currently in operation. At Loviisa, there are two 488 Mwe PWR units and at Olkiluoto two 840 Mwe BWR units. The owner of the Olkiluoto NPP, Teollisuuden Voima Oy (TVO), has opted for storing and, later on, disposing of its spent fuel in a deep geological repository in Finland. The owner of the Loviisa NPP, Fortum Oy (earlier IVO), has since 1997 also followed this strategy. Earlier IVO shipped spent fuel to the USSR/Russia, based on the initial contractual arrangement with the supplier of the reactors and its fuel. The planned long interim storage of spent fuel keeps also other options open.

Conditioning, storage and final disposal of low- and intermediate-level wastes from reactor operation, as well as waste from their decommissioning, will take place at the NPP sites.

2.2 National legislation

According to the Nuclear Energy Act of 1987, licenses for nuclear facilities are granted by the Government. However, in the first authorisation phase (Decision in Principle), the Parliament has the right to overrule the Government's decision on building major nuclear installations, such as a nuclear power plant or a waste disposal facility. The consent of the proposed host municipality for the nuclear installation is a necessary prerequisite for the Decision in Principle. Furthermore, a positive statement by the Radiation and Nuclear Safety Authority (STUK) on the safety of the facility is called for.

The principles of the waste management policy were originally set in the Finnish Government's policy decision of 1983 and later in the decisions by the Ministry of Trade and Industry (MTI). These decisions set also a target schedule for the preparatory works of waste management.

The general safety regulations are issued by the Government while STUK gives the detailed ones.

2.3 Organisational structure

The utilities have the financial and operational responsibility for nuclear waste management. They founded in 1995 a joint company, Posiva Oy, for the research, development, planning and later implementation related to spent fuel disposal. MTI oversees that implementation of waste management and related R&D complies with the national policy and that financial provisions for future waste management costs are adequate. STUK is responsible for the control of nuclear safety and for the technical and safety related review of license applications and other important documents.

The Advisory Committee on Nuclear Energy gives support to MTI and the Advisory Committee on Nuclear Safety to STUK in their major duties concerning nuclear energy and safety. To guarantee the financing of future waste management operations, money is collected from the utilities to the State Nuclear Waste Management Fund according to the annual decisions by MTI.

2.4 Overall Schedule

Spent fuel management

The progress has been in good compliance with the Government's policy decision of 1983. Below are given the most important past and near future milestones:

- Extension of the interim storage capacity was completed in 1987 at the Olkiluoto NPP and will be completed in 2000 at the Loviisa NPP. At both sites, there will be enough storage capacity until early 2010s.
- The selection of a disposal site for spent fuel disposal was launched by an area screening reported in 1985 and in 1999 Posiva proposed to site the repository at Olkiluoto.
- Technical plans and safety assessments for spent fuel disposal have been regularly updated; the latest updating took place in 1999.
- The EIA process for spent fuel disposal was initiated in 1997 and completed in 1999.
- The first formal authorisation application (Decision in Principle) was submitted to the Government in spring 1999.
- The construction license process is scheduled to start in 2010 and the operating license process in 2020.

Reactor waste management

Low and intermediate level wastes from reactor operations are disposed of in the bedrock of the power plant sites. The construction of the repository at the Olkiluoto site began in 1988 and the operation in 1992. The construction of the repository at the Loviisa site was started in 1993 and the Government granted the operating license in 1998.

Decommissioning of nuclear power plants

Wastes from the decommissioning of the reactors are planned to be disposed of in underground repositories co-located with the repositories for operational reactor wastes at the power plant sites. The utilities shall maintain decommissioning plans for the nuclear power plants. Updated

plans must be submitted to the authorities for review at regular intervals of five years; the latest reporting took place at the end of 1998.

2.5 Costs and Funding

To ensure that the financial liability is covered, the utilities must each year present cost estimates for the future management of nuclear wastes. The latest cost estimates, based on waste quantities at the end of 1999 and decommissioning of NPPs, arise to about FIM 6 600 million (USD 1 100 million) with no discounting.

The utilities are obliged to set aside a certain amount of money each year to the State Nuclear Waste Management Fund. The funded money covers currently 89% of the liability. For the outstanding liability, i.e. due to future costs not yet covered by the contributions paid into the fund, the licensee must furnish securities as a precaution against insolvency. The administrative procedures are described in detail in the nuclear energy legislation.

2.6 International Co-operation

The representatives of the Finnish research institutes, authorities and utilities participate in the waste management related co-operation within the European Union, OECD/NEA and IAEA. There is also co-operative nuclear waste research between the Nordic countries. Posiva Oy has formal bilateral co-operation agreements with the SKB (Sweden), NAGRA (Switzerland), and AECL & Ontario Power Generation (Canada).

Finland is actively participating in the nuclear waste management related research projects of the Nuclear Energy Programme of the European Commission. Active research co-operation contacts with the Äspö Hard Rock Laboratory Project are continuing as well.

3. Storage systems

3.1 National Policy

The national policy is based on storing spent fuel and nuclear wastes at the power plant sites until they are disposed of in Finland.

3.2 Requirements

The amount of spent fuel from the Loviisa plant during its planned lifetime of 40 years, will be about 1 070 tU. Because about 330 tU has been shipped to Russia, a storage capacity of approximately 740 tU is needed. The spent fuel arising at the Olkiluoto plant is estimated to be 1 870 tU, based on 40 years' operation.

3.3 Description

At the Loviisa plant, the storage capacity is about 300 tU. In addition to the refuelling pools, there is a pool, where fuel is stored in baskets, and a newer fuel rack pool. After the ongoing enlargement the storage capacity will be 610 tU.

At the Olkiluoto plant spent fuel is initially cooled for a few years in the water pools in the reactor buildings with capacity of about 370 tU. Subsequently, spent fuel is transferred to an on-site facility with three storage pools, 400 tU/each with high-capacity fuel racks.

At Loviisa, reactor wastes are stored in tanks (wet wastes) and in storage rooms (solid wastes) at the plant. At Olkiluoto, dry waste and bituminized wet waste are stored inside the plant before transfer to the disposal facility.

3.4 Schedule

The KPA-store at Olkiluoto was commissioned in 1987. The newest water pool facility at the Loviisa NPP was commissioned in 1984; additional capacity will be available by 2001.

3.5 Experience/Status

At the end of 1998 the total amounts of spent fuel in the storage pools of the Loviisa and Olkiluoto plants were about 226 tU and 835 tU, respectively.

By the end of 1998 the accumulated reactor wastes amount to about 2 200 m^3 at the Loviisa NPP. At the Olkiluoto NPP, the respective amount is about 3 600 m^3.

3.6 Safety Considerations

The general safety requirements for nuclear power plants, decided by the Government in 1991, address also interim storage of spent fuel and reactor waste. The more detailed safety requirements are given in the decisions and guides of STUK. The safety assessments for storage of spent fuel and reactor waste have been included in the FSARs for the nuclear power plants.

No major safety-related incidents associated with interim storage of spent fuel or reactor waste have occurred

4. Transportation systems

Between 1981 and 1996, fifteen shipments of spent fuel from Loviisa to the Russia were performed and in total about 330 tU of spent fuel was shipped. Casks of TK-6 type and a special train were leased from Russia for the transportation. Due to the Amendment of the Nuclear Energy Act, the shipments were finished at the end of 1996.

At Olkiluoto spent fuel is transferred from the storage pools inside the reactor units to the interim store at the NPP site. The transfer cask is of CASTOR-type designed according to the specifications of TVO spent fuel.

As the reactor and decommissioning wastes are stored and most likely will also be disposed of on-site, there is no need for off-site transports of these wastes.

5. Disposal systems

5.1 National Policy

Spent fuel

The nuclear legislation requires disposal of spent fuel into the Finnish bedrock. Spent fuel will be stored in water pools for some decades and thereafter, encapsulated and transferred to an underground repository at a depth of about 500 m in crystalline bedrock.

Reactor waste

The national policy is to dispose of all low and intermediate level wastes in rock cavities at the NPP sites. The disposal facility at Olkiluoto was taken into operation in 1992 and the one at the Loviisa NPP in 1998.

5.2 Requirements

Reactor waste

The estimated total amounts (as packed) of different waste types, employed in the safety analyses of the repositories, are the following:

Utility	Dry maintenance waste	Solidified wet waste	Decommissioning waste	
			Activated	Contaminated
TVO; Olkiluoto	5 600 m^3	3 100 m^3	5 500 m^3	23 700 m^3
Fortum; Loviisa	2 400 m^3	5 400 m^3	4 500 m^3	8 800 m^3

Spent fuel

The estimated amount of the spent fuel to be disposed of in Finland, arising from 40 years operation of NPPs, is approximately 2 600 tU. However, increase of the nuclear capacity and extension of the lifetime of the existing NPPs is under discussion.

5.3 Regulations

Reactor waste

The Government's decision on the general safety requirements on reactor waste disposal was issued in 1991. More detailed requirements are given in STUK's decisions and guides.

Spent fuel

In 1999, the Government made a decision on the general safety requirements for spent fuel disposal.

5.4 Site Selection

Reactor waste

At the end of 1970s, the nuclear power plant sites at Olkiluoto and Loviisa were chosen as candidate locations for repositories of low and intermediate level reactor wastes. The suitability of these sites was confirmed by comprehensive investigation programmes carried out at both sites.

Spent fuel

The selection process for a spent fuel disposal site has included the following stages:

- In 1985, based on site screening 102 potentially suitable areas were identified.
- In 1987, five areas, including the Olkiluoto NPP area, were selected for the preliminary site investigations.
- In 1992, three most appropriate sites (Romuvaara, Kivetty and Olkiluoto) were included in the shortlist of sites for detailed investigations.
- In 1997 site investigations were started also at the Loviisa NPP site (Hästholmen).
- Environmental impact assessment (EIA) procedure was launched in 1997 in the four municipalities and was completed in fall 1999.
- In May 1999, Posiva submitted to the Government a Decision in Principle (DiP) application where Olkiluoto is proposed as the disposal site.
- In January 2000 STUK submitted its preliminary safety appraisal related to the DiP-application.
- In January 2000, the host municipality, Eurajoki, of the Olkiluoto site gave its approval related to the DiP-application.

5.5 Underground Research

Presently, there is no large-scale underground research laboratory in Finland but some experiments are done in a research tunnel co-located with the LILW repository at Olkiluoto. Posiva Oy renewed in 1998 the co-operation agreement on the continuation of the research in the Swedish Äspö Hard Rock Laboratory (HRL). A deep undergound research facility is planned to be established at the Olkiluoto site.

5.6 Repository Concepts

Reactor waste disposal

The repositories for low- and intermediate level reactor waste are located in the bedrock of the two nuclear power plant sites. The designs of the Olkiluoto and Loviisa repositories are somewhat different mainly because of the local geological conditions. At Olkiluoto the host rock massif favours vertical silo-type caverns, whereas at Loviisa horizontal tunnels are more suitable.

At the Olkiluoto site the host rock consists of an intact tonalite massif with fresh or brackish groundwater. The repository consists of two silos at the depth of 60-95 m, one for bitumenized intermediate level wastes, the other for dry maintenance waste. The diameter of the silos is 24 m and the height 34 m. The silo for maintenance waste is a shotcreted rock silo. The silo for bitumenized waste consists of a thick-walled concrete silo inside the rock silo. All wastes will be emplaced in concrete boxes that take e.g. 16 drums.

The bedrock of the Loviisa site on the island of Hästholmen consists of rapakivi granite. The repository is located at the depth of approximately 110 m in a zone of very saline groundwater. Accordingly, the groundwater around the repository is almost stagnant. The repository consists of two tunnels for dry maintenance waste and a cavern for immobilised wet waste. This cavern has been excavated but the construction and installation works will be completed later.

The encapsulation plant is planned to be located at the disposal site. Spent fuel would be encapsulated in copper-iron canisters each containing 12 BWR or PWR fuel assemblies. The canister design consists of an inner cast iron insert as a load-bearing element and an outer container of oxygen-free copper to provide a shield against corrosion. The canisters are emplaced in boreholes drilled at the floors of tunnels, which are constructed at a depth of about 500 m in crystalline rock of good quality. The annulus between the canister and the rock walls of the boreholes will be filled with compacted bentonite. During closure the tunnels will be backfilled with a mixture of crushed rock and bentonite.

The predesigns of the encapsulation and disposal facilities, operational and post-closure safety assessments and summaries of site characterisation are included in Posiva's Decision in Principle application and in its reference reports. STUK's preliminary safety appraisal of the Decision in Principle application was published in January 2000.

Disposal of decommissioning wastes

The latest updatings of the decommissioning plans were published in 1998. The plan for the Loviisa NPP is based on immediate decommissioning while for the Olkiluoto NPP, a safe storage period of about 30 years prior to dismantling is envisaged. The disposal plans for wastes from decommissioning of the NPPs are based on the extension of the on-site repositories for reactor wastes. Besides the dismantling wastes, also activated metal components accumulated during the operation of the reactors will be disposed of in those repositories. The engineered barriers are selected taking account of the radiological and other safety related characteristics of each waste type. A special feature the decommissioning plans is the emplacement of large components, such as pressure vessels and steam generators, in the disposal rooms as such, without cutting them in pieces.

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FRANCE

1. Main events and general policy

Following the decisions announced by the government on December 9, 1998 the main event in 1999 was, on August 3, the signature by the government, of three decrees in the framework of the law 91-1381 concerning research in radioactive waste management :

- the decree authorising ANDRA to implement and operate at the Bure site, in Eastern France, an underground laboratory in order to study deep geological formations where radioactive waste could be disposed of;
- the decree giving general guidelines to set up local committees in charge of following the activities implemented in underground laboratories;
- the decree deciding the creation of a commission composed of three members in charge of the dialogue prior to selecting one or several granitic sites for a second underground laboratory.

ANDRA plans to sink the shafts of the Bure underground laboratory in the course of the 2nd semester of the year 2000.

A bill concerning transparency and the safety and control of nuclear activities and leading to a new organisation of the control of nuclear safety is in preparation as decided on December 9, 1998 by the Government. It should be brought to the national assembly in the course of the year 2000.

2. Very low-level waste

Very low-level waste mainly originates from the dismantling of nuclear power plants (10 000 to 50 000 m^3/year). It has a specific radioactivity of a few becquerels or less per gram. Efforts are being made to rationalise its management. The corresponding regulatory framework has been set up through a ministerial order signed in December 1999.

This rationalisation will lead to new waste management options. Beginning March 1999, a conventional melting plant has been authorised to recycle VLLW resulting from the decommissioning of decontaminated UF_6 transportation containers. ANDRA and France-Déchets announced in 1999 the setting up of a partnership to create a dedicated VLLW repository next to the Aube Disposal Centre.

In the category of low-level and very low-level waste, there is a sub-category consisting of waste which contains a long-lived natural radionuclide, radium, and produces radon. A special method of disposal is currently being studied by ANDRA for this type of waste. This is closely followed by the French Nuclear Safety Authority.

3. Short-lived low or intermediate level wastes

Short-lived low-level or intermediate-level waste is generated by nuclear reactors, fuel reprocessing plants, research centres, nuclear industry and laboratories (15 000 m^3/year). The reference technical solution adopted for the long-term management of this type of waste is disposal in a surface repository where adequate waste packages are disposed of in concrete structures. This provides for containment of the radionuclides during a sufficient length of time for their activity level

to decay. In the past, this type of waste was disposed of at the Manche Disposal Centre. It is disposed of, since 1992, at the Aube Disposal Centre. These two Centres are operated by ANDRA.

For surface disposals, an important issue is the definition of the conditions for entering the surveillance phase. With regard to the Manche Disposal Centre (surface repository), which operation ended in 1994 and which is now set to enter the surveillance phase, the French Nuclear Safety Authority makes sure that the recommendations laid down by the committee on the subject set up in 1996 by the ministers for Industry and for Environment are applied. The French Nuclear Safety Authority is now processing the corresponding license application that the operator, ANDRA, submitted in 1998. The safety report was examined by the Standing group of experts in December 1998. A public inquiry took place. It is held as part of the licensing procedure for entering the surveillance phase. The public inquiry will concern as well the revision of the ministerial order for authorisation of effluent release relative to this facility.

The Aube Disposal Centre was authorised by a decree of September 4, 1989. Its lifetime is planned for 30 years and could be extended to 60 years as the quantity of waste yearly received has drastically decreased. Following the provisions of the creation license, issued in 1989, ANDRA sent the final safety report for the repository to the French Safety Authority, in December 1996, integrating operating feedback from the first years of operation. This report was examined by the standing group of experts in November 1997 and June 1999. On this basis the definitive operating license was granted on September 2nd 1999. In parallel, the authorisation for effluent releases is in the process of being revised.

In May 1995, the French Nuclear Safety Authority defined, in the basic safety rule RFS III.2.e, revised requirements for radioactive waste package acceptance for disposal in a surface repository. The respective responsibilities of ANDRA and the waste producers are precised in this rule. The Safety Authority carries out inspections to check that the acceptance procedures comply with the requirements of RFS III.2.e and are correctly implemented. Taking into account the experience feedback and the final safety report of the Aube Disposal Centre, the RFS III.2.e is currently in the process of being revised.

A new facility, CENTRACO, has been licensed to operate at the beginning of 1999. It receives short-lived low-level or intermediate-level waste either for incineration or, in the case of metal scrap, for melting. It contributes to minimisation of the volume of the waste before its disposal in a surface repository.

The short-lived medium and low level wastes include certain categories which have characteristics making them unsuitable for acceptance at the Aube Disposal Centre. These are wastes containing tritium, which is difficult to confine, and also graphite waste, which contains a non-negligible proportion of long-lived radionuclides. A working party comprising regulator, waste producers and implementer is entrusted with devising the most suitable management channels for these types of waste. ANDRA is studying dedicated repository designs for these types of wastes.

4. Research concerning long-lived radioactive waste

Long-lived radioactive waste containing alpha emitters is divided into intermediate-level and high-level waste. The former derives mainly from the process, the operation and maintenance of reprocessing facilities (1 600 m^3/year). The latter stems from fission and activation products arising from the reprocessing of spent fuel (240 m^3/year).

Disposal options for this type of waste, currently stored on the production sites, are being sought along the lines specified by law 91-1381 concerning radioactive waste management, passed on December 30, 1991.

This law requires the implementation of a fifteen years research programme along three areas of research:

- Research of solutions to separate and transmute long-lived radionuclides in the waste ;
- Studies of retrievable and non retrievable disposal in deep geological layers with the help of underground laboratories;
- Studies of processes for conditioning and long term surface storage of these waste.

The research on the first and third area is led by the CEA. The research on the second area is led by ANDRA. The government confirmed in December 1998 that the three areas of research should be given equal weight.

In the area of the research on transmutation, the Phenix fast breeder reactor at Marcoule will be used to study plutonium burning and minor actinide transmutation.

In the area of conditioning and longterm storage, the government approved the recommendations of a report by the CEA to initiate basic design projects by the year 2000. The surroundings of Marcoule will be considered as a possible location for the implementation of a sub-surface interim storage facility.

Important decisions have been taken in the disposal area. After a 7 years long process including mediation, public inquiries and technical assessments, on December 9, 1998 the French government decided that the research on geological disposal should be performed at two sites : a clay site at Bure (East France) and a granitic site to be selected.

On August 3, 1999 a decree authorising ANDRA to implement and operate at the Bure site an underground laboratory in order to study deep geological where radioactive waste could be disposed of, was signed by the Government. Investigations and experiments in the underground laboratory should allow to gather the necessary data for the conception, the optimisation, and the respect of retrievability and safety of a potential repository on the site.

ANDRA plans to sink the shafts of the underground laboratory in the course of the 2nd semester of the year 2000.

In 2006, a global evaluation report on the three areas of research will be produced by the National Evaluation Commission and transmitted to the Government. On this basis one of the selected sites for a deep geological laboratory could be proposed to the Parliament as the location of a repository.

5. Interim storage of historical radioactive waste

For all waste for which a final solution has not been found, it is essential that satisfactory temporary solutions are implemented. The French Nuclear Safety Authority makes sure that these temporary solutions are not only safe, but also that they do not become definitive as a result of lack of action. In this respect, the French Nuclear Safety Authority has started the utilities essentially CEA

and COGEMA to begin a clean-up of their installations where historical waste is temporarily stored. After a review of COGEMA programme in this field, the French Nuclear Safety Authority has conducted in 1999 a general review of CEA programmes. The September 1999 issue of "Controle", the magazine of the French Nuclear Safety Authority was dedicated to the subject of historical waste.

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GERMANY

1. Basic contents of the coalition agreement

It is one of the Federal Government's major objectives to find a comprehensive legislation to phase out the use of nuclear energy during this term of office. This involves an amendment of the current Atomic Energy Act with regard to this phase out.

The following are plans in the field of disposal contained in the coalition agreement of 20 October 1998:

- A national plan for the orderly disposal of nuclear waste is being developed.
- One single final repository in deep geological formations is enough for the final disposal of all kinds of nuclear waste.
- A target date for the final disposal of highly radioactive wastes is the year 2030.
- Doubts have arisen as to the suitability of the Gorleben salt dome. The exploration is thus to be discontinued and further sites in different host rocks are to be explored for their suitability. The decision on a suitable site will be taken on the basis of a subsequent comparison of all sites including the Gorleben site.
- A storage of radioactive wastes at the Morsleben site will be discontinued. The plan approval procedure will be restricted to the decommissioning of the site.
- As a basic rule every plant operator has to establish interim storage facilities at the site of the power plant or in the vicinity. Spent fuel will only be licensed for transport if there are not sufficient interim storage capacities at the plant and the plant operator cannot assume responsibility for a storage on site. Interim storage sites will not be used for final disposal.

2. Implementation of the coalition agreement

So-called consensus talks about the future of nuclear energy between the Federal Government and the utilities started in January 1999. About 18 months later, on 14 June 2000, the basic document on nuclear consensus in Germany was agreed upon. This agreement has been reached between the Federal Government and Germany's four main nuclear utilities (EnBW, RWE, Veba and Viag). According to this consensus document, the Federal Government and the utilities agree to limit

the future utilisation of the existing nuclear power plants. On the other hand, keeping a high safety level and fulfilling the requirements pursuant to the Atomic Energy Act for the remaining period of utilisation, the undisturbed operation of the nuclear power plants shall be guaranteed.

Both sides shall contribute their share to implement the contents of this agreement permanently. On that basis the Federal Government shall elaborate the draft of an amendment of the Atomic Energy Act. The Federal government and the utilities shall assume that this agreement and its implementation will not lead to claims for compensation between the parties involved.

2.1 Legal framework

In implementing the coalition agreement, the Federal Environment Ministry is striving for an amendment of the Atomic Energy Act. Elements of the national disposal plan which is currently being formulated will be legally reflected in this amendment. It includes for example, the fundamental restriction of the disposal of irradiated fuel elements to their direct final disposal as well as the obligation to set up decentralised interim storage facilities at the site of the power plant. Moreover, a comprehensive amendment of the Radiological Protection Ordinance is currently taking place in view of the implementation of the EURATOM basic safety standards.

With regard to NORM residues it is planned that there will be a graded control system dependent on the type of material and its radioactive concentration for inclusion in and exemption from the scope of nuclear and radiation legislation. This control system will range from unlimited to limited use of radioactive waste and to its disposal.

2.2 Interim Storage

In Germany spent fuels not destined for reprocessing and vitrified residues are stored at central facilities on an interim basis.

In the future it is planned that every operator of a nuclear power plant will in principle have to establish interim storage capacities at the power plant or in its vicinity. With a few exceptions, plant operators have already taken the initiative and established interim storage capacities or placed an application for a permit for such interim storage capacities.

2.3 Ultimate storage

2.3.1 Morsleben

Based on a court decision issued on 25 September 1998, the Magdeburg Higher Administrative Court (OVG) decided in summary proceedings that a storage of radioactive wastes in the eastern parts of the Morsleben ultimate storage site (ERAM) is to be prohibited, awaiting a final decision in the pending main proceedings.

On the basis of current safety considerations, in particular with respect to problems arising from the development of a concept for backfilling and sealing, the Federal Government has no plans of resuming a storage at ERAM at present. A resumption of storage at ERAM depends on the result of investigations currently underway.

2.3.2 Gorleben

The suitability of the Gorleben site for a final disposal of all types of radioactive waste is controversial among experts and a decision has therefore not yet been taken. The Federal Environment Ministry is therefore currently developing procedures and new criteria for a suitability assessment and intends to discontinue the exploration work owing to the doubt that exists over the suitability of the Gorleben site. In particular, the following questions arise:

1. The release of radionuclides through gas formation due to corrosion or degradation.
2. Proof of permissible irradiation that is not limited by time.
3. Criticality safety.
4. The hazard potential of human influences.
5. Guaranteeing the recoverability of irradiated fuel elements.
6. The necessity of a multiple barrier system.
7. Compatibility with criteria currently being developed, in particular geoscientific criteria.

According to the agreement between the Federal Government and the utility companies of 14 June 2000, the investigation of the Gorleben salt dome shall be interrupted for at least 3 years, however for 10 years at maximum, until conceptual and safety-related questions have been clarified.

2.3.3 Konrad

The former iron ore mine Konrad in Salzgitter is planned as a final disposal site for radioactive waste with negligible heat generation. The plan approval procedure which has been underway for 17 years in the meantime, is at an advanced stage. In 1998, the planning approval authority formulated a draft plan approval decision which was practically complete. It included all the required permits with regard to water laws. The applicant's consultation on secondary provisions has taken place. The assessment is complete. With regard to long term safety an unlimited period of proof has been considered and the storable activity inventory has been limited to such an extent, that according to the model calculations, the values from Article 45 of the Radiological Protection Ordinance are always adhered to.

As the responsible planning approval authority, Lower Saxony's Environment Ministry is currently examining whether and to what extent it has to consider the strived for lowering of the hazardous incident planning values to 20 mSv, within the framework of the amendment of the Radiological Protection Ordinance. It is also examining whether in its opinion, a sufficiently specific need for the final disposal project is given. The planning approval authority has hitherto not informed the Federal Environment Ministry of any technical or legal points of view, which would be grounds for refusing the requested plan approval decision.

According to the agreement between the Federal Government and the utility companies of 14 June 2000, the responsible authorities shall complete the licensing procedure for the Konrad repository according to the legal provisions. The applicant has to withdraw the application for immediate enforcement of the plan-approved decision.

2.*3.4 Investigation of other sites*

The Federal Environment Ministry has set up a working group to select sites for the final disposal of radioactive wastes. Its task is to develop a comprehensible selection procedure for final

disposal sites on the basis of scientific criteria. In this way, the prerequisites for a new final disposal concept should be created and it will be geared towards transparency and acceptance.

2.4 Transport of irradiated fuel elements and vitrified residues

Since May 1998 the transport of irradiated fuel elements has been suspended, due to incidents with contaminated fuel element storage casks. The protection measures planned by the nuclear and reprocessing plant operators against exceeding the allowable contamination limit values were subjected to a swift and thorough expert examination. A plan of action and a catalogue of criteria have been formulated, and are to be implemented and adhered to by the energy supply industry in particular, with a view to a possible resumption of transports. On 25 January 2000 the Federal Office for Radiation Protection, as the responsible authority, authorised the transport of spent fuel elements from the Biblis, Neckarwestheim and Philippsburg nuclear power plants to the interim storage site at Ahaus.

3. Basic research and development

The Federal Minister for Economics and Technology (BMWi) has taken over from the Federal Minister for Education and Research (BMBF) basic research and development for radioactive waste disposal. This task is independent of the direct works for planning, construction and licensing of repositories in Germany. In this context a number of R&D projects are carried out in the Asse salt mine in Germany as well as in the underground laboratories at Grimsel (Switzerland), Äspö (Sweden), Mol (Belgium) and Mt. Terri (Switzerland).

They are primarily focused on:

- characterisation and long term stability of geological barriers;
- behaviour and interaction of geotechnical and geological barriers;
- radionuclids behaviour in multibarrier systems of geologic repositories;
- developing and testing of tools and methods for PA.

Paramount objective of this R&D programme is to develop a profound system understanding for the most potential host rock formations for high level waste and spent fuel disposal.

For this reason the budget of 1999 has been split into 25% for rock salt, 45% for granite and claystone and 30% for non rock type specific research. The results can be used for any considerations with respect to alternative disposal concepts. This applies in particular to the development of both an efficient multiple barrier system concept as well as an safety related site characterisation programme.

The highlights of last year’s research have been:

- termination of the main phase of the “BAMBUS” *in situ* tests in the Asse resulting in an advanced set of data on the behaviour of rock salt and salt backfill under heat load;
- conclusion of tunnel near field experiments in granite in the GTS together with NAGRA, US DOE and ERL/ITRI of Taiwan with particular emphasis on fluid flow phenomena;

- further development of the EMOS PA-code including the adaptation of a modular structured network system and its application in the EU co-funded SPA-project;
- performance of a 2-phase-flow experiment in granitic rock in HRL Äspö.

In the R&D programme on "Entsorgung" and radioactive waste disposal mainly the three national laboratories FZJ, FZK, FZR as well as GRS and BGR have been involved.

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HUNGARY[4]

1. Geological research

Geological research on site selection for a LLW/ILW radioactive waste repository was conducted in 1997 and 1998 at the Üveghuta site. Engineering work necessary for the preparation of a preliminary environmental impact report was also carried out. The experts and environmental protection groups interested were continually informed regarding the results of the research at specialised forums. General public was also continually informed via press conferences and the media.

The Geological Institute of Hungary recommended in its closing report on geological research activities published at the end of 1998 that detailed work on the geological and site properties – forming the basis for the licensing and construction procedures – should start in the Üveghuta research area. These research results were presented to a broad professional community and they found general support.

Some experts have called however into question the completeness of the research work and the deductions drawn from the results in certain areas (e.g. hydro-geology, seismology), and a political debate emerged.

2. Peer review

To promote achieving consensus the International Atomic Energy Agency was asked to organise a WATRP (Waste Management Assessment and Technical Review Programme) mission to carry out a peer review for the validation of the activities and results of the site selection and to give

4. See Country Focus in Nuclear Waste Bulletin N° 13.

recommendations based on international good practice. IAEA accepted the Hungarian request and has organised an international expert team.

The key issues of the WATRP mission were the following:

- Short overview of the screening process resulting in the selection of Üveghuta region for on site exploration, including the preliminary safety assessment. The purpose of this step was to make acquainted the international experts with the activities before the site investigation started in Üveghuta.
- Evaluation of the in situ geological investigation programme (1996-1998), the applied methods and criteria against the international practice.
- Analysis and assessment of the results and conclusions of the site investigation programme as contained in the final report of the Geological Institute of Hungary (1998).
- Expert opinion on the completeness of the geological investigations to start the licensing procedure, or further eventually needed investigations, as well as the suitability of the Üveghuta site based on the present results.

The team's approach to this review basically included:

- evaluation of the documents provided by the Hungarian organisations involved;
- presentation and discussion of the major aspects of the Hungarian work in a review meeting in Budapest (22-26 November 1999);
- a visit to the candidate site for the disposal facility at Üveghuta.

The Chairman of the team presented the main results of the review in a press conference. The main findings were:

- the process that led to the selection of the Üveghuta site appears reasonable and has appropriately considered both the Hungarian geology and public acceptance;
- the Üveghuta site appears potentially suitable to develop a safe repository for disposal of low and intermediate level operational and decommissioning wastes from nuclear power generation, the site characterisation and repository design, however, should continue;
- the probability of any adverse effect on the safe performance of the planned repository at Üveghuta due to seismicity is very low;
- based on a meeting with local representatives (Public Control and Information Association), an effective and open communication programme appears to have been established.

The following recommendations were made by the team:

- The Hungarian licensing criteria, as reflected in the relevant ministerial decree, are very prescriptive, concerning geologic requirements in particular, compared to international requirements and guides. We suggest greater flexibility be provided that would emphasise total system safety based on a combination of engineered and natural barriers to achieve safety.

- Some clarification is needed of the design concept and the kinds of engineered barriers to be included in the design. Safety should be achieved through a combination of engineered and natural barriers.
- The safety assessments that were provided to the team were based on limited early geologic investigations. There is a need for an integrated safety assessment using the currently available site and conceptual design information, and including a broader spectrum of scenarios. The integrated safety assessment should form a basis for continued site characterisation, and preferably be prepared, at least in part, before presenting the case to Parliament.
- The safety assessments to date have focused on long term performance. As the design concept matures, there is a need to consider potential radiation exposures of workers and the public, as well as conventional mine safety, during repository operation.

The review team provided more detailed findings, views and recommendations for future work in a detailed report. The immediate step to be taken is – as recommended by the mission – the preparation (at least partly) of an integrated safety assessment based on the available data to define the further needs for the geological investigations. This is also supported by a PHARE project aimed at a hydro-geological research programme and assistance in the safety evaluation of the site.

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ITALY

Two main actions are presently underway:

- a site selection process for identifying a suitable site for location of a LLW repository and an interim storage for HLW and spent fuel;
- the conditioning of the LLW and HLW wastes stored at the ENEL and ENEA sites and the decommissioning of the facilities.

1. LLW Repository project and site selection process

ENEA has continued actions directed to select and qualify a site for the final repository for LLW. The special Task Force, purposely appointed in 1996 to implement the required actions, is now carrying out intensively :

- conceptual design of a LLW repository based on a vault concept;
- an extensive geographic screening covering the national territory to identify suitable areas for the localisation of the system, which will include the centralised facility for spent fuel and other long lived radioactive wastes.

The comprehensive geographic screening activity began in 1998, based on a GIS methodology, which allowed first to elaborate a National Map of Suitable Areas for a LLW repository

location. The further development presently underway will be concluded by the end of 2000 with the identification of the areas at regional scale.

A special Working Group has been set up within the Conference State-Regions, a permanent Institution of Italy for dealing with problems of common interest between the central government and local administrations, charged of identify and propose a procedure and methodology for the site selection with the required level of consensus. How to implement a volunteer methodology is presently considered. The working group has to present its conclusion to the Conference by the next June. Several hearings have been managed by the working group with the organisations directly or indirectly involved in the waste disposal (ENEA, ANPA, Civil Protection, Universities, etc).

2. Conditioning and decommissioning

The detailed design activity for the vitrification plant to be built at the ENEA pilot reprocessing plant Eurex is underway. The vitrification station is expected to be in operation in 2003.

At the Trisaia Research Centre (southern Italy) the cementation plant SIRTE, which solidified from 1995 to 1997 all the liquid LLW stored at the site has been upgraded for allowing the solidification of the some 3 m^3 of high active liquid produced during the reprocessing campaign of the ITREC pilot plant. The solidification of the liquid wastes began in November 1999. From January 2000 the plant is under routine operation. More than 100 drums of High Active cemented waste have been produced.

ENEA has under way a licensing procedure for a dry storage system for the spent fuel presently stored at the Trisaia Centre. The system is expected to be available for transferring the spent fuel from the pond by 2004. A similar dry system is planned at the Eurex plant for the 54 spent fuel elements of the Trino type under storage in the pond.

The conditioning of the radioactive waste at the ENEL shutdown nuclear power plants continued. From November 1999 the previous ENEL subsidiary SOGIN became a formally independent company for managing the formerly nuclear activity of ENEL. The main achievements during 1999 are:

- The cementation of the LLW at the Garigliano NPP is completed. The dismantling of the Radwaste System of the power station is presently under way.
- At Caorso shut-down reactor the international tender for the supply of a system for the thermal treatment and conditioning of decommissioning waste is under way. Conclusion is expected by summer.
- As for decommissioning activity, formal application for Caorso, presented in 1997, is still pending approval by the Ministry of Industry. For the Trino shut-down station the application has been presented.
- At the other two dismissed stations, Latina (Magnox) and Garigliano (BWR), the decommissioning activity continued. The main achievment at Latina in 1999 was the complete removal and cutting of the gas circulation system.
- As for the spent fuel, SOGIN is pursuing the completion of the Service Agreement with the BNFL by sending the remaining 53 t of spent fuel from the Avogadro storage pool to Sellafield. The transportation contract is expected to be signed by the end of 2000 and executed in 2001.

- For the remaining spent fuel (285 t), a dry storage system is planned. SOGIN is finalising the international tender among two qualified vendors. The decision on the selected system is expected by the end of March 2000.

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JAPAN

1. New national programme

In June 1999, the Atomic Energy Commission (AEC) started discussions to make a new long-term programme of research, development and utilisation of nuclear energy. The latest programme was released in June 1994. The AEC set up a long-term programme council with six sub-committees to address the following subjects:

1) Nuclear energy and general public
2) Nuclear fuel cycle including radioactive waste
3) Fast breeder reactors
4) Frontier research
5) Radiation utilisation, and
6) International relations

2. LLW disposal programme

The Low-level Radioactive Waste Disposal Centre of the Japan Nuclear Fuel Limited (JNFL) has been in operation at Rokkasho-mura in Aomori Prefecture since 1992. The JNFL is permitted to dispose of 400 000 drums at the centre, and has already buried 130 000 drums of homogeneous waste from nuclear power plants by the end of 1999. Solidified low-level radioactive mixed wastes such as metals, thermal insulators and plastics are planned to be disposed of at the facility.

The Advisory Committee on Nuclear Fuel Cycle Backend Policy (hereinafter "the Advisory Committee"), the AEC discussed the disposal policy for comparatively high level β/γ waste such as spent control rod, burnable poison, reactor internals, which are from operation and decommissioning of nuclear power plants. The Advisory Committee published the report on the policy to dispose of these wastes in October 1998, and proposed the concept of around 50-100m depth underground disposal for higher radioactive level wastes. Following this report, the Special Committee on the Safety Regulations of Radioactive Waste, established by the Nuclear Safety Commission of Japan (NSC), is discussing the guidelines of regulations on these wastes disposal.

The Advisory Committee also discussed the treatment and disposal of the low-level wastes arising from nuclear research facilities and radioisotope users, and issued the report entitled

"Guidelines on Treatment and Disposal of Radioactive Waste from Radioisotope Facilities and Research and Other Facilities" in May 1998. Following this report, the NSC is discussing the basic concept on the regulations of disposal of these wastes since June 1998.

Having introduced the concept of "clearance" into the regulatory policy of radioactive waste in mid-1980s, the NSC started approaches toward establishing of clearance levels in May 1997. The NSC started with the development of the unconditional clearance levels for solid materials arising from operation and decommissioning of nuclear reactors, and identified possible exposure pathways in disposal and recycle and/or reuse of these wastes. The Special Committee on the Safety Standards of Radioactive Waste, the NSC, issued the report entitled "Clearance Levels for Solidified Materials Arising from Nuclear Reactors in Japan" in March 1999.

3. HLW disposal programme

In accordance with the national programme defined by the AEC, Japan Nuclear Cycle Development Institute (JNC), former Power Reactor and Nuclear Fuel Development Corporation (PNC), which was reorganised on 1 October 1998, is required to submit the second progress report (hereinafter called "H12 report"), including an integrated performance assessment, to the government by the year 2000. Since its establishment in September 1995, the Advisory Committee has been discussing ways in which future R&D programmes relating to HLW geological disposal should be conducted. These discussions are based on the recognition that this is an urgent issue and that it is essential to formulate concrete technical measures for geological disposal. In addition, it is important to provide information on every detail of these activities in order to obtain public understanding and acceptance of disposal projects.

3.1 Guidelines for the second progress report of R&D on HLW disposal

The PNC's first technical first progress report (hereinafter H3 report) issued in 1992 provides a comprehensive evaluation of the technical relevance of geological disposal and demonstrates the feasibility of ensuring safe geological disposal in Japan. The H12 report, which is founded on the basis of the achievements identified in the H3 report, demonstrates the technical reliability of the geological disposal and provides key input for site selection and development of regulations. In this context, the Advisory Committee had considered issues such as the approach to R&D to be performed by the PNC (now JNC) in cooperation with relevant agencies and organisations, the way to identify technically important issues and how to evaluate research results objectively and transparently in the H12 report, and issued the guidelines on 15 April 1997, entitled "Guidelines on Research and Development relating to Geological Disposal of High-level Radioactive Waste in Japan". In the guidelines, the H12 report is required not only to demonstrate clearly the technical reliability of the specified geological disposal in Japan, but also to provide a scientific and technical basis both for the siting procedure to be adopted by an implementing organisation for HLW disposal and for the development of an appropriate regulatory infrastructure. Therefore the H12 report plays an important role in the overall HLW disposal programme.

The first draft of the H12 report was submitted to the Advisory Committee and presented to professionals in Japan for comments in September 1998. After taking into account of comments, the second draft was published in April 1999, and after the international peer review by OECD/NEA, the report was finalised in November 1999. The H12 report was submitted to the AEC, and is now under the evaluation by the AEC.

In parallel with the R&D programme, there is also a plan in the national programme that an implementing organisation for HLW disposal will be established around the year 2000 to site a repository. The programme will step from the generic phase into the site-specific phase. Development of site characterisation methodologies will become a more important issue as the national programme progresses.

3.2 Research coordination committee for further R&D on HLW disposal

Obtaining public understanding and confidence is an essential component of performing R&D relating to geological waste disposal. A considerable investment of manpower and economic resources over an extended period is also necessary for such an activity. Close cooperation among the research organisations involved in R&D activities is required for real progress to be made. To this end, the JNC, which acts as the core organisation for R&D, the Japan Atomic Energy Research Institute (JAERI), the Geological Survey of Japan (GSJ), the National Research Institute for Earth Science and Disaster Prevention, the Central Research Institute of the Electric Power Industry (CRIEPI), universities and private sector agencies are in close cooperation to conduct R&D programmes, with support from power companies, to make maximum use of available expertise. It is important that a technical foundation for geological waste disposal in Japan is established through these joint efforts. The JNC and other organisations involved have been working in close cooperation to conduct R&D work in an effective and efficient manner. In the guidelines, it is suggested that a "Research Coordination Committee" be organised with the aim of promoting the sharing of results among different organisations and strengthening mutual cooperation as part of preparation of the H12 report.

3.3 QUALITY Project

Construction of a radiogenic facility for acquisition of fundamental data on nuclide migration has been finished at the JNC Tokai Works in the QUALITY (Quantitative Assessment Radionuclide Migration Experimental Facility) Project in August 1999 and the facility is now in operation. The major purpose of the QUALITY Project is to acquire data on glass dissolution, nuclide solubility and radionuclide migration behaviors under simulated geological conditions by controlling the atmosphere in the glove boxes.

3.4 The report on how to implement HLW disposal

The Special Committee on High-Level Radioactive Waste Disposal (hereinafter "the Special Committee") was established in September 1995 by the AEC. The Special Committee has been considering various aspects of HLW disposal, including social and economic aspects, with a view to ensuring that such disposal will be accepted by the Japanese public in the coming century. Based on its discussions, the Special Committee released a draft report on how to implement HLW disposal in July 1997. The draft report was opened to the public for comments. In parallel with calling for comments, a series of meetings for open discussion with the general public were held in 6 cities; Osaka, Sapporo, Sendai, Nagoya, Fukuoka, and Tokyo. After the review of comments made by the general public, the report entitled "Basic Approach to the Disposal of High-level Radioactive Waste" was published in May 1998. The report consists of two parts. Part 1 discusses general considerations relating to implementation of HLW disposal. Part 2 highlights four specific issues essential to implement disposal of HLW: 1) how to promote public understanding of HLW disposal, 2) how to build public confidence on disposal technology and construct an institutional arrangement for

implementation, 3) how to coexist with local communities at the disposal site and 4) how to proceed with site selection.

Following this report, the Nuclear Energy Sub-Committee of the Advisory Committee for Energy has been deliberating on backend measures such as disposal measures of high-level radioactive waste since July 1998. On March 23, 1999, an interim report on "How to institutionalise disposal business of high-level radioactive waste" was completed. A result of the discussions on high-level radioactive waste is that the reasonable estimation of disposal cost is 2 700-3 100 billions yen (11 typical cases). The report also shows 1) roles of the government, implementing entity and electric utilities for disposal business, 2) formation of implementing entity, and 3) security of operating fund. Following the report the Ministry of International Trade and Industry (MITI) is preparing a bill about HLW disposal.

Following the Special Committee's report, the NSC has been discussing the basic concept on the regulations of HLW disposal since June 1998.

3.5 Returned vitrified high-level waste from overseas reprocessing

Japanese electric power companies receive reprocessing services for their spent fuel from COGEMA of France and BNFL of the United Kingdom. Under the contracts between these European reprocessors and the Japanese electric power companies, COGEMA and BNFL are entitled to return the vitrified residues to the Japanese electric power companies, and both COGEMA and BNFL have decided to return them.

The total quantity of vitrified wastes to be returned from both reprocessors is estimated approximately three thousand and five hundred canisters at this stage. Vitrified wastes are securely placed inside specially designed transport casks, and the transport is made by sea using a specially designed vessel. The cask and the vessel are designed and manufactured in accordance with all the relevant safety standards of the International Atomic Energy Agency (IAEA) and the International Maritime Organisation (IMO). The transport of vitrified wastes from France and the U.K. to Japan is expected to last about 10 years once or twice a year. The first returned vitrified wastes from France were unloaded at Mutsu-Ogawara port of Rokkasho-mura in Aomori Prefecture on 26 April 1995. They were to be stored and managed in the Vitrified Waste Storage Centre of the JNFL at Rokkasho-mura. Each of vitrified wastes was checked for appearance, surface contamination, size, weight, containment, radioactivity calorific value, etc. After checking of the inspection data, and confirmation and approval by the Science and Technology Agency (STA), the vitrified wastes were placed in the storage pit. All the returned vitrified wastes will be stored there for some 30 to 50 years.

Transports have been carried out four times by the end of 1999, and 168 canisters have been returned from France safely. 104 canisters were added by the fifth transportation from France in February 2000.

4. TRU waste disposal programme

Waste containing TRU elements is generated at the JNC Tokai Reprocessing Plant and MOX fuel fabrication facilities. In the near future, waste from overseas reprocessing will be returned and the JNFL commercial reprocessing plant under construction at Rokkasho-mura, northern part of Japan, will join the waste sources.

In accordance with the national programme of the AEC, the JNC has been conducting R&D on TRU waste disposal in co-operation with the JAERI. Utility companies are required to support these R&D efforts as original waste generators. In order to carry out R&D effectively, the JNC and the utility companies agreed to establish a co-operative project team on 24 June 1997. The project team consists of representatives from the JNC, the utility companies, the CRIEPI and the Radioactive Waste Management Centre (RWMC). Activities were initiated on 1 July 1997. The Advisory Committee started discussing the disposal policy on radioactive waste including TRU elements in December 1998, and the draft report was made open to the public for comments in December 1999. The report is expected to be finalised in March 2000.

5. Decommissioning

As Japan's basic philosophy on decommissioning of nuclear facilities, commercial power reactors are considered to be dismantled and removed as soon as possible after their operations are completed, taking into account safety, social issues and reutilisation of their site. Based on this philosophy, the Japan Power Demonstration Reactor (JPDR) decommissioning programme was conducted by the JAERI from 1981 to 1996. After the development of decommissioning technologies during 1981 to 1986, actual dismantling of the JPDR was conducted to verify the usefulness of the technologies for future use in dismantling commercial power reactors. The programme was successfully completed by the end of March 1996. The extremely low level radioactive waste arising from demolishing the JPDR biological shield was disposed of into the near surface burial place as a safety demonstration test. R&D of advanced decommissioning technologies has been conducted based on the lessons learned from the JPDR decommissioning programme. In addition, the JAERI Reprocessing Test Facility (JRTF) decommissioning programme started in December 1996 to demonstrate the dismantling of fuel cycle facilities. Dismantling activities are in progress and the programme will complete in 2004. The Japan Research Reactor No.2 (JRR-2) was finally shut down in December 1996. The JRR-2 decommissioning programme was then started to remove core part in one piece. It will complete by 2007.

The Tokai Power Station, which is the oldest commercial gas-cooled nuclear power plant of the Japan Atomic Power Company (JAPCO), completed its commercial use in March 1998. The spent fuels are being removed, and it will be completed by next year. This will be the first case of decommissioning commercial nuclear power plant in Japan. The decommissioning plan is being prepared. The regulatory procedure is planned to start within a few years. Since the Fugen Nuclear Power Station, which is the prototype of advanced thermal reactor, will be shut down in a few years, the preparatory study on decommissioning the Fugen was started in 1999 by the JNC.

The Nuclear Energy Sub-Committee discussed reasonable estimates of the treatment and disposal costs of dismantled radioactive waste from decommissioning of nuclear facility. Based on the discussions, the treatment and disposal cost of 1.1 GW nuclear power plant is estimated at about 20 billions yen.

6. Partitioning and transmutation

In Japan, several organisations are carrying out R&D of Partitioning and Transmutation (P-T) technology under the OMEGA programme (Options for Making Extra Gains from Actinides and fission products) which was initiated in 1988. P-T is not regarded as an alternative to geological disposal, but considered to have a potential to reduce the volume, or changes the isotope distribution,

of wastes requiring deep disposal. In February 1999, the Advisory Committee started checking and reviewing the outcome of the OMEGA programme up to now and how to proceed the R&D on P-T technology further. The draft report was opened for public comments in December 1999. The report is expected to be finalised in March 2000.

7. Public understanding of radioactive waste disposal

Following the AEC decision in June 1998 to enhance public understanding of HLW disposal, the STA is holding a series of symposia with AEC special advisors on the subject of radioactive waste. Eight symposia were held in 10 locations throughout the country; Sizuoka, Kyoto, Fukushima – Ohkuma (connecting two studios by TV conference system), Hiroshima, Aomori, Kagoshima, Chiba – Kashiwazaki (connecting two studios by TV conference system), and Matsuyama. More than 10 symposia will be held throughout the country in 2000.

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KOREA

1. General

Currently 16 NPPs (Nuclear Power Plants), of which the total capacity is about 13.7 GWe, are in operation and, in 1999, provided more than 40% of the electricity in the Republic of Korea. At present about 55 320 drums (200liters) of LILW is stored at four NPP sites and about 4 040 drums of LILW from RI applications and research institutes at NETEC (Nuclear Environment Technology Institute) site. The cumulative amount of spent nuclear fuels from those NPPs is approximately 4 080MTU and this is being stored at different NPP sites either wet pools or dry storage facilities.

2. Programme for LILW management

The NETEC as a special organisation of KEPCO (Korea Electric Power Co.) performs siting for a LILW repository, its construction and operation as well as collection and treatment of the wastes from RI applications, and R&D on the treatment of operational wastes from NPPs. This institute performed a conceptual design and a preliminary safety assessment of LILW near surface repository in assumed site with the established waste acceptance criteria. Also this institute has a plan of promoting the disposal siting in 2000. On the other hand, the construction of a pilot plant with a cold crucible melter for spent ion exchange resin and dry active waste, and a plasma torch melter for non-combustible waste was completed at the end of September 1999 and this plant has been in operation to develop a vitrification technology for the volume reduction of NPP operational wastes and then to establish an industrial scale vitrification plant in Korea.

Regulating and licensing of nuclear facilities in Korea are performed on the basis of the legal provisions of the Atomic Energy Act, Enforcement Decree, Enforcement regulation and the Notice of MOST (Ministry of Science and Technology) in Korea.

Restructuring of relevant Laws for radioactive waste management was taken place in 1999. Such provisions as national dose limits came on the Enforcement Decree from lower level. Since the Enforcement Decree of the Atomic Energy Act prescribes general standards in the generic terms on the various practices applicable for the radioactive waste management facilities, it is also needed to develop and revise criteria and guides in detail for siting, design, construction, operation, environment surveillance and so on. Relevant technical criteria and/or guides have been developing by KINS (Korea Institute of Nuclear Safety) since 1990. They would be a part of supplements to the Enforcement Decree of the Atomic Energy Acts. At this time more than 20 criteria have been developed as guide for licensing and inspection of both LILW repository and spent fuel interim storage facility.

3. R&D programme for HLW disposal

The R&D for the high-level radioactive waste disposal at KAERI (Korea Atomic Energy Research Institute) has been performed since the early 1997 in order to develop a reference repository system in Korea up to the year of 2006. The relevant R&D activities consist of three fields, i.e. geoscience environment research, system development and performance assessment, and radionuclide migration study.

The Korean peninsula is located in the marginal area of the stable Eurasian continent, which links to the west Pacific mobile belt. Thus the geological environment of Korea differs from Japan archipelago and China plateform. For the geotectonic history in the peninsula, the Mesozoic orogeny is most important, accompanying folding, fault block movement and igneous intrusion. The lithology of the Korean peninsula consists of a complex structure of 29 rock types from Archean to Quaternary. By the result coming from the screening process for identifying rock types to be further studied for HLW repository, the primary host rock will be Mesozoic Plutonic rocks, which are occupied by nearly one third of the peninsula. The second choice will be gneissic rocks among the Precambrian basement.

In the first phase study with one of the screened rock types, seven different disposal options were scrutinised and ranked by KAERI experts. Then the most feasible option, vertical emplacement with separate disposal rooms for CANDU and PWR spent fuels was developed. The optimum distances between deposition holes and tunnels were determined by Thermo-mechanical analysis. To assure the post closure long-term radiological safety, the relevant Features, Events, and Processes (FEPs) were identified and subsequently a number of feasible scenarios were established. To assess the safety of the disposal concept for the specific scenarios, an overall total system performance code, MASCOT-K, was developed. The one-dimensional PSA code has been and shall be supported by many detailed unit models for colloidal transport, canister life time and etc. Also reference input data sets were collected from the reference surveys and laboratory experiments in KAERI.

Radionuclide behaviour in deep repository environment has also been studied to provide the performance assessment group with the relevant data for the radiological safety assessment. The geologic medium is so much heterogeneous as to have distinct mineralogical composition. Firstly KAERI has studied on the sorption behaviour of radionuclide focusing on the single minerals of oxide group. Experiments are carried out with typical radionuclides for high-level radioactive waste and the results are modeled by SCM to be extended to the interpretation of the data for the composite and natural material. For the effective management of radionuclide sorption data for different geologic

media under various groundwater conditions, KAERI has developed a tool for the management of sorption database with a function of graphic user interface, SDB-21C. Radionuclide transport experiments through a single fracture of laboratory scale both of artificial and natural granite samples have also been conducted and will be continued to enhance the fundamental understanding of radionuclide transport characteristics.

4. D&D project of the TRIGA Mark-II and III

The decontamination and decommissioning (D&D) project of TRIGA Mark-II and III was started in January 1997 and will be completed in December 2008 when the repository for the disposal of LILW will be operational. The decommissioning plan, environmental impact assessment and decommissioning design were performed in 1998. In July 1998, all of the spent fuels from the TRIGA Mark-II and III were safely transported to the United States.

At the end of 1998, the decommissioning plan was submitted to MOST for license. It was reviewed by KINS in 1999. Then the review report was again review by the expert Group for radiation environment, one of the four sub-groups of the Committee for Nuclear Safety, in January 2000. The recommendation made by the expert Group will be submitted to the Committee for its final approval.

Practical dismantling work will begin when the license is issued and it will be continued up to 2006 or 2007. Simultaneously research and development in the field of D&D will be carried out for the future D&D of other nuclear facilities including nuclear power plants.

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NORWAY

1. The Himdalen facility

The national combined repository and storage facility for low and intermediate level radioactive waste at Himdalen, about 40 km east of Oslo, was inaugurated 24 September 1998. The formal owner of the facility is the Directorate of Public Construction and Property (Statsbygg), and Institute for Energy Technology (IFE) has been granted license by the Government to operate it.

After an operational test period, during which also operation and maintenance agreements were concluded between the Ministry of Trade and Industry and IFE about financing, and between Statsbygg and IFE about responsibility, the transport of the first waste containers took part in March 1999. During 1999 a total of 630 waste containers have been transported to the new facility from IFE's radioactive waste treatment plant at Kjeller where another 2 500 containers (mostly steel drums) are stored. The transport of these containers to Himdalen is expected to be finalised by the end of 2002. This includes the retrieval of about 1 000 drums buried in a near surface repository at IFE's premises at Kjeller.

2. High-level radioactive waste – spent nuclear fuel

In December 1999, the Government granted renewed license for operation of the research reactors in Halden and Kjeller. In this connection, public and political focus was set on the future fate of the spent nuclear fuel from these reactors. The fuel is now safely stored at the sites, but no decision has been made for the long-term storage and final disposal. The Government decided to appoint an independent expert group to discuss these questions and come up with a document describing different strategies and options for the future storage and final disposal of the spent fuel.

Further information can be obtained from:
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SPAIN

1. General radioactive waste plan

The 5th General Radioactive Waste Plan was approved last July by the Government. The Plan contains a revision of all the necessary activities and technical solutions applicable in the different areas of radioactive waste management, and covers an updated economic-financial study of the costs of such activities. This new Plan changes significantly the approach and time schedule of the spent fuel and high level waste management strategy in relation to the former Plan. It states that no decision on the final solution of spent fuel and high level waste will be taken before 2010, and stresses the need of a Centralised Interim Storage facility by that date. This facility should serve not only to store the spent fuel after starting the decommissioning of the nuclear power plants, but also to accommodate different wastes and materials not amenable to be disposed of at the El Cabril disposal facility, for instance high level waste and fissile materials to be returned from reprocessing and other long-lived or high level waste arising from different sources, in particular from the dismantling of nuclear power plants.

1.1 Low and intermediate level waste

The Plan stresses the importance of El Cabril Centre as the fundamental basis for the management of low and intermediate level waste (L/ILW) in Spain. This facility provides an integrated management system that includes waste collection, transport, treatment and conditioning and accurate information on the waste inventory, radiological characterisation and quality assurance, all of which is compatible with the type of disposal applied.

The Plan addresses the following activities to be performed in this field in the coming years:

- continuing waste volume reduction at the NPPs;
- R&D activities (as durability of concrete, definitive covering layers, etc.) in order to improve the different involved processes and their adaptation to future situations;
- in the medium term, to analyse the requirements for additional storage capacity; and

- to optimise the current available capacity by the management of very low level wastes.

1.2 Decommissioning and dismantling of nuclear installations

The Plan confirms the strategy chosen for the dismantling of Vandellós I nuclear power plant, now in progress; this is to release 80% of the site during the initial phase (level 2), following a waiting period of some 30 years before undertaking the total dismantling (Level 3).

For the remaining nuclear power plants, all of them Light Water Reactors, and for the purposes of calculation and planning, the alternative of total dismantling (level 3) is considered in the Plan. This will be initiated 3 years after the definitive shutdown of the reactors and following removal of the spent fuel from the plant pool and of operating L/ILW.

The Plan emphasises the necessity to progress in the establishment of clearance criteria for certain waste materials having very low radioactive content for their subsequent management as conventional wastes.

1.3 Spent Fuel and High level wastes

The approach adopted in the 5th Plan as regards spent fuel and HLW make a distinction between the temporary and definitive technological solutions, and considers a period of analysis prior to establish in detail the required strategies and actions.

Concerning a temporary solution, the strategy is:

- On the one hand, to have available by the year 2002 a temporary dry storage facility for the Trillo NPP spent fuel due to lack of capacity in its pool. In this context it is worth mentioning that, last July, the government approved the construction of such a facility at the NPP site.
- On the other hand, to have available a centralised temporary storage (CTS) facility by the year 2010, in order to solve the problem of storage of vitrified wastes and fissionable materials coming from reprocessing. This installation will also be required to store other wastes that can not be stored at El Cabril as well as of spent fuel itself, due to lack of capacity at NPPs pools or that their dismantling works are addressed.

The CTS might be complemented with individual facilities at certain NPPs or with another facility serving various such plants.

Regarding final disposal, the new proposed strategy is based on the fact that no decision for a final solution will be taken before 2010. The major highlights of the proposed strategy for the coming years will be the following:

- No further geological studies will be performed until a final decision will be finally taken. The existing geological data will be elaborated in order to be used in the performance assessment of the deep geological disposal facility (DGD).
- Non-site specific conceptual repository designs of deep geological repositories in granite, clay and salt will be slightly modified to introduce the retrievability criteria.

- Safety performance assessment of deep geological repositories will continue to play an important role, integrating geological information, repository design and R&D data. The ENRESA-2000 assessment will be performed to provide quantitative indications of the evolution of the repository, to guide R&D activities and to optimise facility designs. These exercises will consider the possible influences of the new fuel cycle technologies, related to separation and transmutation.

1.4 R&D Programme

The 5th Plan underlines the desirability of completing within the next R&D Plan the efforts initiated in the previous years, in relation to both resources and infrastructures, for the development of characterisation techniques and methodologies.

Based on the new strategy established in the 5th GRWP the R&D Plan 1999-2003 contemplates the following basic goals:

- Continue R&D on geological disposal to provide data and models for the ENRESA-2000, and maintain the technological know-how developed for site characterisation and barrier performance evaluation.
- Promote R&D on partitioning and transmutation, consistent with the technical capabilities of Spain in order to evaluate the feasibility and implications of these new technologies in the final disposal.
- Intensify international collaboration through the 5th R&D Framework Programme of the European Union and/or bilateral agreements with other agencies to continue research on underground laboratories and participate in P-T international projects.

2. Ongoing activities

2.1 Low and Intermediate Level Waste

The El Cabril disposal facility is in operation since 1992. As of December 1998 some 11 800 m^3 of conditioned waste had been disposed of, and some 4 500 m^3 of conditioned waste were placed in the existing storage facilities at the installation.

In compliance with the renewal operation permit a new Safety Analysis of the installation is being performed aiming at optimising its capacity and obtaining a major flexibility in the application of the waste acceptance methodology. This up-dated Safety Analysis is mainly based, on the one hand, on a better knowledge of the waste characteristics and, on the other hand, on the results of the research projects carried out up to now.

The wastes arising as a result of the so-called Acerinox incident (the smelting of a radioactive source of ^{137}Cs), along with the scrap produced during the industrial process that caused contamination of some plants, the equivalent volume of which amounted some 1 100 m^3 on arrival at the El Cabril facility, are now in temporary storage in the containers used for their transport, pending treatment and subsequent definitive disposal.

2.2 Decommissioning and dismantling of nuclear installations

In February 1998, following the issuing of a favourable report by the Nuclear Safety Council, and of the corresponding Environmental Impact Statement by the Ministry of the Environment, the Ministry of Industry and Energy authorised the Vandellós I NPP Closure and Decommissioning Plan. The dismantling works are in progress and will continue with the disassembly of the conventional components and active parts, as well as on development of the materials and waste management plan. Currently, discussions are being held with the Nuclear Safety Council in order to agree a reliable methodology to clear material with very low radioactive content, including the monitoring procedures. The level 2 decommissioning is expected to be reached by 2002.

The dismantling and restoration works carried out by ENRESA in Andújar Uranium Mill and by ENUSA-ENRESA in La Haba uranium concentrates production facility have been completed, and the site monitoring tasks are in progress in accordance with the requirements established in the Conditions set by the Nuclear Safety Council.

The restoration works in 19 old disused uranium mines are being carried out by ENRESA under a programme expected to be completed in 2000.

2.3 Interim storage of spent fuel

Reracking has been completed at all nuclear power plants with the result that Trillo NPP will become saturated following the 2002 refuelling outage and the rest will experience this same problem progressively as from the year 2013. In order to solve the near term shortage storage problem of Trillo NPP, the Government approved on 31 July 1999 the construction of an on site dry storage facility, the project of which is now underway by means of dual purpose metal casks.

2.4 Definitive management of spent fuel and high level wastes

The programme is being adapted to follow the guidelines provided in the new Plan. The ENRESA-2000 Performance Assessment exercise will be the focal point to orient the future R+D projects, most of which will be developed in the framework of the European Union’s R+D programme taking advantage of the existing underground research laboratories.

3. Other topics

At the end of 1999, Protocol for collaboration on the radiological Surveillance of Metallic Materials was agreed and signed by the Ministry of Industry and Energy, the Ministry of Public Works, the Nuclear Safety Council, the Radioactive Waste Management Company, the Union of Iron and Still Companies and the Spanish Federation of Recovery. The objective of this Protocol is to establish the conditions required to undertake the radiological surveillance of metallic materials and resulting products with a view to detecting the possible presence of radioactive materials and avoid the risk of their becoming dispersed and irradiating or contaminating people, property and the environment.

The Protocol is applicable to the recovery, storage or handling of metallic materials for recycling and to the processing of metallic materials.

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SWEDEN

1. Report by the Implementer, SKB

1.1 General

As consequence of a three party agreement Swedish Government decided in 5 February 1998 to recall the operating permit for the 1st unit in the Nuclear Power Plant at Barsebäck. In accordance with this, operation was permanently terminated November 1999. Decommissioning strategies and plans are being developed.

1.2 Waste management

The Swedish system for management of radioactive waste consists of a ship based transportation system, a final repository for low and medium level waste (SFR) at the Forsmark nuclear plant, and a central interim storage facility for spent nuclear fuel (CLAB) at the Oskarshamn nuclear plant.

The sea transportation system has operated without disturbances. During 1999 a total of 73 transport casks with spent fuel and 17 with core components have been transported from the nuclear power plants to CLAB, where a total of about 3 100 tonnes of spent fuel was stored at the end of 1998. To meet future needs SKB is expanding the CLAB facility from present 5 000 tonnes to 8 000 tonnes. Permission for this was granted in August 1998, and 50% of the excavations have been done by February 2000.

About 65 containers of low and medium level waste have been transported to SFR. At the end of 1999 a total of 26 000 m^3 had been disposed of in the facility.

1.3 RD&D programme

In September 1998 SKB presented their RD&D programme 1998 with *inter alia* its plan to select sites for site investigations and provide background information for this decision by the end of year 2000. A review of the SKB report was conducted and published by The Swedish Nuclear Power Inspectorate, SKI in April 1999 (see below).

A Government Decision was issued in January 2000 where the they recognised that the legal requirements had been fulfilled, and presented requirements for the continued R&D work and for the content of the background information needed before sites are selected for site investigation

The R&D work is carried on in accordance with the RD&D programme 1998 with adjustments to accommodate various review comments.

As a part of the information basis required when selecting sites for site investigations, SKB published in December 1999 a new post closure safety analysis (SR 97) of the deep geologic disposal of spent nuclear fuel (the so called KBS-3 system). SKI has asked NEA to form an international team to review the report. This review has been finalised in May 2000.

1.4 Siting

The Swedish siting process foresees 5-10 studies to be made of the feasibility to site a deep repository in various communities in Sweden. After that two sites are selected for surface based site investigations to form the basis for an application for a permit for detailed investigations from tunnels or shafts on one site. Feasibility studies involve studies in a number of areas to evaluate what a siting of a deep repository would mean locally, e.g. regarding geology, technique and environment, as well as economy, employment, infrastructure and tourism. A site investigation involves site characterisation with core drilling and geophysical methods.

Feasibility studies are presently going on in 6 Swedish communities. The reporting is ongoing and will be finalised during year 2000.

1.5 The Äspö HRL

The reporting of the 10 year long R&D-activity to investigate and test methods available for site investigations has been completed, and 5 summarising reports have been published in the SKB series of Technical Reports. The reports where discussed together with similar efforts in other countries in the Third Äspö International Seminar at the Äspö Hard Rock Laboratory in June1998.

Presently ongoing activities at Äspö HRL focus on:

- testing of models describing the barrier function of the host rock;
- demonstration of disposal technology and the performance of safety barriers.
- conclusion of the investigations and testings of the methodology for detailed geo-scientific investigations.

1.6 The Canister Laboratory

In 1998 the operations started at SKB Canister Laboratory. It will be the centre for development of encapsulation technology and for training of personnel. Equipment for the sealing of the copper canister and for the quality control of this seal will be tested. Important steps in the work up to 2001 are:

- to commission the electron beam welding equipment to full capacity;
- to establish basic parameters for welding equipment;
- to achieve a flawless and controllable welding process;
- to establish operational availability and maintenance needs.

2. Report by the Regulators, SKI and SSI

2.1 General

SKI's responsibilities in the field of nuclear waste management are:

- issuance of regulations and guidance;
- review and supervision of safety in waste management and disposal;
- review of SKBs R&D programme (report required every 3rd year);
- review of SKBs cost calculations of future costs for waste management and decommissioning. Recommendation on a fee on electricity production to the government;
- information.

Major activities this year are focussed on development of regulations, review of SKB's safety assessment report SR-97 and a report on long-term safety of long lived low- and intermediate level waste and on the supervision of the extension of the facility for intermediate storage for spent fuel, CLAB. SKI is also engaged in information activities in the municipalities where feasibility studies are going on. SKI is also much engaged in R&D to develop SKIs competence and capacity as a reviewer of SKBs programmes and plans.

SSIs responsibilities in the field of nuclear waste management are to review the industry's waste plans from the radiation protection point of view. In the case of high-level waste, SSI reviews the RD&D programme of SKB and delivers its statement to SKI, or jointly with SKI review the safety reports. Such collaboration is currently going on with regard to the reports on long-term safety for disposal of spent fuel and other long-lived waste submitted by SKB. One of the utilities has applied for an extension of its shallow land burial for low-level waste. This application is currently being reviewed by SSI. Such facilities are licensed by SSI.

In all areas where radiation protection issues are concerned (including all aspects of waste handling), SSI may issue those regulations deemed necessary from a radiation protection point of view.

2.2 Regulations

SKI is developing regulations in different areas of nuclear safety:

- Regulation on general safety requirements for nuclear facilities in operation also covers waste management facilities including the operational phase of repositories (entered into force 1 July 1999).
- Regulation on long term safety of final disposal of long-lived nuclear waste. This regulation will include aspects on safety assessment methodology, including time frames. The regulation has been sent for comments internationally. A compilation of national and international comments is available in English. New draft is being prepared (planned to enter into force during 2000).
- Other regulations are under development (including regulations on decommissioning of nuclear facilities).

The importance of co-ordination and harmonisation of SKI and SSI regulations is recognised.

SSI's Regulations (SSI FS 1998:1) on the Protection of Human Health and the Environment in Connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste entered into force on 1 February 1999. The essential elements of the regulations are:

- the final management shall be optimised and take due account of best available technique;
- collective doses shall be calculated for comparative purposes;
- a risk target of 10-6 per year for individuals representative of the most exposed regional population;
- protection of biological diversity and biological resources;
- two time-frames; the first 1 000 years and the period from 1 000 years and beyond;
- the consequences of human intrusion shall be assessed.

Although the regulations were not approved until fairly late in the preparation of SKB's safety analysis SR 97, SKB has adjusted their risk calculations for different scenarios to the criteria set by SSI. Further work is going on within SSI to develop secondary level criteria based on SSI FS 1998:1, concurrently with the review of SR 97.

A draft regulation on the handling of radioactive waste at nuclear installations is being finalised during 2000. The regulations focus on planning and documentation in conjunction with generation and handling of radioactive waste.

The SSI has revised its regulations on limitations of discharges from nuclear power plants. The new regulations on protection of human health and the environment in connection with discharges from nuclear installations, re-establishes the limit of 0.1 mSv annual effective dose to average individuals of the critical group. An investigation level is proposed if there are indications that discharges over a 12-month period would give rise to critical group doses above 10 microSv.

2.3 Review of SKB´s Programme for Research, Development and Demonstration (FUD-Programme 98)

According to the Act on Nuclear Activities, the nuclear industry is responsible for carrying out a comprehensive R&D Programme on final management of spent fuel and nuclear waste, and to report on progress at three-year intervals. In September 1998 SKB submitted its new programme to SKI. The programme has been reviewed by a large number of national organisations, including SSI. In April 1999 SKI delivered its recommendations to the government. In its decision in January 2000 on SKB's RD&D programme -98 the government said that the programme fulfils the requirements in the Act on Nuclear Activities. The government also requires some complementary information from SKB.

2.4 Decommissioning

During 1999 SSI continued to prepare for future decommissioning of nuclear facilities in Sweden. The work was partly performed in collaboration with the Swedish Nuclear Power Inspectorate SKI. SSI focused on three specific topics:

- Identify and name the different phases during which decommissioning is performed and establish a terminology. A working team has proposed a division of the decommissioning work in suitable phases and a related vocabulary. This proposal is presently reviewed at SKI and SSI.
- Formulate a policy and suggest possible stipulations regarding timely decommissioning. This work has resulted in a policy document: SSI's Policy Concerning Time-related

Aspects of Nuclear Facility Decommissioning, which was formally effected on November 29, 1999.

- Establish requirements for the licensees regarding planning at various stages of the facility's lifetime. The work resulted in a comprehensive report, which will constitute the basis when SSI, during the year 2000, formulates regulations concerning planning and preparing decommissioning of nuclear facilities.

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SKI is drafting a policy document on decommissioning requirements from a safety point of view with an emphasis on different steps in decommissioning and the specific requirements that could be coupled to these steps and also with emphasis on the total system (dismantling, waste categories, transportation and final disposal).

2.5 Planned research projects related to radioactive waste management

General on R&D activities for 2000 (SKI)

SKI is planning for a rather comprehensive R&D programme (2-3 MUSD). The basis for planning is SKI's regulatory role; review and supervision of safety in nuclear facilities, review and supervision of SKB's R&D programme (required by law) and review and supervision of the funding system for future costs for management and disposal of spent fuel and radioactive waste and the decommissioning of nuclear facilities.

SKI has established an R&D programme that will include several issues; treatment technology and storage, repository technology, geochemistry, geology, hydrology, steel/copper canister, safety assessment/risk communication and methodology for cost calculations. As much of SKI's R&D is related to Safety Assessment Methodology this is described in a separate paragraph.

Safety indicators (SSI and SKI)

SSI and SKI jointly explore the use of other safety indicators than dose and risk. The collaboration includes the development of a hierarchically structured set of safety indicators. An example of a possible indicator, which is often discussed, is the flux of (radio) nuclides from the geosphere to the biosphere. Research will be needed for "base-line" studies, i.e. the establishing of suitable reference levels etc.

Risk communication (SKI and SSI)

The recent development in the Swedish nuclear waste disposal programme has put new demands on the regulators (SKI and SSI). It has become evident that transparent decision making procedures must be developed, that allows insight from people outside the group(s) of expert(s) and political decision-makers. SKI and SSI have therefore jointly financed a project concerning transparency in risk assessment. A pilot study was concluded in the beginning of 1998. This study was followed by an application by an international consortium, including SKI and SSI, for financing through the EU 5th Framework Programme a large project for developing and testing, some of the recommendations put forward in the pilot study. Contract negotiations will begin shortly.

Furthermore, SSI and SKI (together with the consultant for the pilot study), as well as the EC DG Environment, the US Nuclear Waste Technical Review Board, and the Swedish National Council for Nuclear Waste, organised a symposium on Values in Decisions on Risk (VALDOR; Stockholm, 14-17 June, 1999).

Safety Assessment Methodology (SKI)

SKI has concluded its project SITE-94, a major effort in development of competence in safety assessment methodology. SKI continues its efforts to develop competence in this area e.g. to continue the development of scenario methodology, modelling of radionuclide transport, time dependent factors in modelling, use of site specific data etc. SKI is also building competence in canister corrosion, influence on repository performance by concrete, redox buffering etc. SKI is also planning to develop new models and methodology as a follow up of SITE-94. Also the repository for low and intermediate long lived radioactive waste will require development of performance assessment methodology.

Biosphere assessments (SSI)

Research is carried out on environmental criteria as well as assessment methodology. The criteria development draws upon existing rationales for management of chemical (and other) risks, including end-point definitions etc, and intends to adapt these schemes – to the extent desirable and possible – to the field of radioactive waste. Frameworks for review of proponents submissions, in the context of SSI regulations, are being developed, taking into account support for analysis of environmental impact and relevant biosphere features, events and processes.

Environmental protection is considered in the Swedish Radiation Protection Act. Contract negotiations have started concerning a major research project on Framework for Environmental Impact Assessments – FASSET – within the 5th Framework Programme. The project, co-ordinated by SSI – specifically addresses environmental protection issues. Also other aspects of environmental radionuclide transfer are covered by U-financed projects in which SSI are engaged.

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SWITZERLAND

1. Nuclear power

Swiss nuclear electricity production again reached a high level in 1999. The nuclear component (23 500 GWh) as a fraction of total electricity production was 35.3%. In addition, 3 nuclear plants supply thermal energy for industrial or district heating purposes.

2. Centralised interim storage of radioactive wastes

The utility-owned organisation ZWILAG is responsible for storage of spent fuel, HLW and other wastes, for conditioning of specific L/ILW waste streams and for incineration of wastes. Construction of the facility has been finalised and the remaining operational license is expected within the next few weeks. Operation of ZWILAG will commence in a stepwise process. The successful realisation of this interim storage facility relieves the time-pressure for establishing final disposal routes.

3. Programme for disposal of L/ILW

In 1994, the application for the federal general license for a L/ILW repository at the Wellenberg site was submitted and a request for a mining-concession for the repository was made to the Canton of Nidwalden where the proposed Wellenberg L/ILW repository should be sited. At a public referendum in June 1995 the granting of the mining-concession was rejected by a narrow margin (52 to 48%). Within the framework of the general license application, the safety authorities review came to positive conclusions. However, because the project is blocked on the political level the general license procedure has been suspended.

In order to take into account public concerns (mainly monitoring/retrievability and public involvement in decision making), the strategy for repository implementation has been adapted and a more step-wise approach is foreseen where in a first step the concession will be restricted to an exploratory drift only and a concession for the repository will only be submitted after the results from the exploratory drift are available. The repository concept has also been modified and it now includes a phase with easy retrievability (Nagra, 1998).

At the request of the energy minister, a working group discussed technical and socio-economical aspects of the Wellenberg project. In September 1998 the work of the technical group came to an end with positive results (BFE, 1998a). With respect to retrievability, the group agreed with the proposed modified concept for the L/ILW repository.

4. Programme for disposal of HLW and long-lived ILW

Within the HLW repository programme, two host rock options are considered: crystalline bedrock (for which a comprehensive regional field investigation programme has been performed to build up a project database and no additional fieldwork is planned for the time being) and Opalinus Clay. The next milestone of the HLW programme is to demonstrate that sites for a repository in Switzerland exist and can be identified with a high degree of probability. The corresponding documentation will be submitted to the authorities in 2002. This is a high priority goal although actual

implementation of a repository would take place well into this century and is also dependent upon evaluation of multinational options.

For the Opalinus Clay option, drilling of an approximately 1 050 m deep borehole at Benken (25 km north of Zurich) was finalised in spring 1999. The results of this borehole together with the results of a 3-D seismic survey over an area of about 50 km^2 around Benken and the results from the Mont Terri Project (see below) provide an excellent and very promising database to assess the feasibility of a HLW repository.

Besides investigations for a repository in Switzerland, the option of disposing of high-level waste within the framework of a multinational cooperative project is being kept open. Since the eighties, this has been a publicly acknowledged part of the Swiss waste management strategy and corresponding statements have also been made by the responsible minister.

5. Progress of R&D programmes

Within the scope of Phase V at the Grimsel rock laboratory, a variety of experiments are underway in collaboration with partners from other countries (Czech Republic, Germany, Japan, USA, Sweden, France, Spain, Taiwan and the European Community). Phase V is expected to last until 2002.

Furthermore, an international project under the patronage of the Swiss National Hydrological and Geological Survey is underway at Mt. Terri (Canton Jura). The present programme consists of several experiments to obtain information on the hydrogeological, geochemical and geomechanical characteristics of the Opalinus Clay and of similar rocks. Partners are the Swiss National Hydrological and Geological Survey (patronage), ANDRA, BGR, ENRESA, IPSN, JNC, Nagra, Obayashi Corporation and SCK•CEN; the Swiss federal research institute PSI has the status of a supporting research organisation.

Further R&D work is being performed in the areas of modelling, laboratory experimentation and natural analogues. Most of this work is directly funded by Nagra but the Federal Authorities also award contracts and money in selected areas. An important part of this work is being performed at PSI (the Paul Scherrer Institute) within the R&D programme on long-term repository safety; this programme is jointly funded by the Swiss government and Nagra; its main emphasis lies on chemistry of the repository system and radionuclide transport, including retardation.

6. Other items

In connection with the revision of the Nuclear Energy Law, early in 1998 the responsible minister set up a dialogue group (consisting of the nuclear industry and Nagra, opponents, government representatives and their experts) to discuss (besides other issues) the pros and cons of “final disposal in geological repositories” vs “indefinite monitored retrievable storage”. This dialogue came to an end in November 1998 without consensus on this issue (BFE, 1998b). In June 1999 the energy minister implemented a new expert group (EKRA: “Expertengruppe Entsorgungskonzepte Radioaktive Abfälle”) to evaluate the options for long-term waste management of both L/ILW and HLW as input for the revision of the nuclear energy law and for the decision on how to proceed with Wellenberg. Early February 2000 the group presented its report with its many important conclusions and recommendations, excerpts of them cited below:

- Based on current knowledge, geological disposal is the only method for isolating radioactive waste which fulfils the requirement for long-term safety.
- Social demands concerning waste disposal are oriented towards the principle of reversibility. EKRA has therefore developed the concept of monitored long-term geological storage, which combines disposal with the possibility of reversibility. In addition to the actual waste emplacement facility (the main facility), the concept foresees construction of a test facility and a pilot facility and a phase of monitoring and facilitated waste retrieval prior to actual geological disposal. In this sense, the concept of monitored long-term geological storage takes into account requirements for both long-term safety and reversibility. Provided there is no reason to retrieve the waste beforehand, geological disposal will thus be realised in a stepwise manner.
- Geological disposal for all waste types should be foreseen in the legislation. Project planners should be required to document, in ongoing projects, aspects of monitoring, control and facilitated waste retrieval as they apply to the concept of monitored long-term geological storage.
- The way in which the concept of geological disposal is extended to include elements of monitored long-term geological storage is determined by safety considerations.
- Wellenberg L/ILW project: Based on currently available information, the Wellenberg site fulfils the criteria for both geological disposal and monitored long-term geological storage. The project should be pursued, whereby the "modified disposal concept Wellenberg" can serve as the starting-point. The possibilities for monitored long-term geological storage should be investigated from the point of view of location and layout of a pilot facility. The first action at Wellenberg, however, is to take the necessary steps towards constructing an exploratory drift.
- HLW/TRU programme: The host rock currently under investigation – Opalinus Clay – is suitable in principle for both geological disposal and monitored long-term geological storage. Once the Entsorgungsnachweis (project demonstrating the feasibility of disposal) has been accepted, site characterisation should be pushed forward and facility planning and site investigation should be initiated. International disposal options are in no way a replacement for solving the disposal problem within Switzerland itself.

It is important to note that according to this group the ultimate aim of geological disposal has to be maintained. However, implementation needs to consider societal needs. The proposed concept of monitored long-term geological storage is thus the first and very important step towards a passive geological disposal system (and thus not to be confused with long-term interim storage) and provides the time to develop a well-informed societal opinion. It is also important to note that long-term safety considerations will determine how the elements of the proposed geological long-term storage concept will actually be implemented. This will happen within the framework of on-going projects. It is expected that the projects developed on the basis of the now proposed concept of long-term geological storage will in broad terms be compatible with the modified concept for L/ILW at Wellenberg as recently proposed (Nagra, 1998) and also comparable to developments elsewhere.

The draft of the Nuclear Energy Law – which will soon go into a formal consultation phase – is thus expected to rely on the concept of geological disposal.

With respect to the Wellenberg project, it has again been confirmed that it is justified to continue with the site investigation process. It is now up to the political bodies to take the necessary

measures that the process (especially the foreseen public vote on a concession for the exploratory drift) can continue.

Finally, it should be pointed out that an Ordinance is about to come into force that requires a waste management fund independent of the utilities to cover the costs for waste management for the time after the operational period of the corresponding NPP.

7. References

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EKRA 2000: "Disposal Concepts for Radioactive Wastes", Final Report, Expertengruppe Entsorgungskonzepte für radioaktive Abfälle, January 2000.

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UNITED KINGDOM

1. Government Response to the House of Lords Select Committee

On 25 October 1999 the Government issued its response to the House of Lords Select Committee on Science and Technology report on "The Management of Nuclear Waste". The Government proposes to publish a detailed and wide ranging consultation paper on future waste management policy in Spring 2000.

The text of the Select Committee report is available via the House of Lords Publications website at: http://www.publications.parliament.uk/pa/ld199899/ldselect/ldsctech/41/4101.htm.

The text of the Government's response to the Select Committee report is available via the DETR website at: http://www.environment.detr.gov.uk/radioactivity/govtresponse/lords/index.htm.

2. UK CEED consensus conference

The UK Centre for Economic and Environmental Development (CEED) Consensus Conference on Radioactive Waste Management took place on 21-24 May 1999. A consensus conference is a forum at which a citizens' panel, selected from the general public, questions "experts" (or "witnesses") on a particular topic, assesses the responses, discusses the issues raised, and reports its conclusions at a press conference.

The final conclusions of the citizens' panel were as follows:

- Radioactive waste must be removed from the surface and stored underground, but must be monitorable and retrievable. Cost cannot be an issue. Options must be left open for future solutions.
- The panel recommended the appointment of a neutral body appointed by the Government to deal with waste management, including the selection of a national storage site. The criteria for site selection should be open and publicised.
- All institutions handling radioactive waste should conform to the same high standards which should include random scrutiny.
- Research and development must be continued on a much larger scale and international co-operation should be encouraged.
- The panel sees no problem with privatisation if done properly with adequate safeguards.
- At present there is a lack of trust and understanding and public awareness must be raised. The public needs to be fully informed of the problems and solutions available. Decision making must be open and transparent. Radioactive waste issues should be made part of the Government's education strategy.
- The panel was not fundamentally opposed to nuclear power, but it should not be expanded until a way is found to deal adequately with the waste problem.
- A new and internationally accepted method of waste classification is needed, clear and openly communicated to the public as well as industry.
- Existing international reprocessing contracts should be honoured, but no new ones should be taken up.

The text of the Citizens' Panel report is available via the UK CEED website at: http://www.ukceed.org/conference/citizens_panel_report.htm

3. BNFL stakeholder dialogue

On 28 February 2000, the Environment Council published the interim reports of the Waste and Discharges Working Groups from the BNFL Stakeholder Dialogue process. The BNFL stakeholder dialogue involves a wide range of organisations and individuals interested in or concerned about nuclear issues. Its aim is to inform BNFL's company policy for the improvement of their environmental performance in the context of their overall development.

The main findings of the Waste Working Group were as follows:

- The early recovery and treatment of "historic" waste arisings into adequately long-lived forms for above ground passively safe, retrievable, monitorable storage and the prompt treatment of current waste arisings were priorities. Such a policy is acceptable in the interim in the absence of a final disposal or other long-term management solution.
- Waste volumes should be minimised and that the policy and practice of interim storage may have implications for other operational issues. In particular, the timing and justification of decommissioning programmes must proceed against this "passively safe" policy background.
- It is essential that a comprehensive review of the safety and feasibility of disposal is carried out.

The text of the interim reports are available via the Environment Council website at: http://www.the-environment-council.org.uk.

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UNITED STATES OF AMERICA

1. U.S. Department of Energy Office of Civilian Radioactive Waste Management

Currently 104 nuclear power facilities (reactors) provide approximately 20% of the electricity produced in the United States. These reactors contribute between 1 800 and 2 200 metric tons of uranium (MTU) annually to the accumulating amount of spent nuclear fuel (SNF), estimated to be approximately 41 000 MTU at the end of 1999. It is projected that by the year 2040, if all reactors continue to operate, the inventory of SNF will have increased to 85 000 MTU. The Nuclear Waste Policy Act of 1982 (Public Law 97-425) established the Office of Civilian Radioactive Waste Management (OCRWM) within the Department of Energy (DOE) to develop and safely manage a Federal system for disposing of the National SNF and high-level radioactive waste.

1.1 Funding

OCRWM continues to be funded through appropriations from the Nuclear Waste Fund, which is financed through a 1.0 mil per kilowatt hour fee imposed on the utilities for electric power generated and sold by nuclear power facilities. Contributions are as much as approximately $650 million per year. At the end of fiscal year 1999 (FY 99), the fund had received a total of approximately $13.7 billion, including investment earnings, and expended approximately $5.3 billion. In addition, during FY 99 OCRWM also earned approximately $500 million in defence revenue from the Office of Environmental Management and Office of Energy's Naval Nuclear Propulsion Programme, custodians

of the DOE inventory of high-level radioactive waste and spent nuclear fuel. The total accrued defence revenue at the end of FY 99 is approximately $2.6 billion.

1.2 Programme strategy

Funds appropriated by Congress for FY 99 continued to be used toward objectives that maintained the momentum toward a national decision on the geologic disposal option: 1) completion of the Final Environmental Impact Statement next year (FY 01), 2) continuing the necessary work towards a decision on whether to recommend the Yucca Mountain site to the President in 2001, if the site is suitable for a repository, and 3) submit a license application for construction authorisation to the Nuclear Regulatory Commission (NRC) in 2002, if the site is approved by the President and Congress. As discussed below, implementation of programme requirements to reflect this strategy continued throughout 1999 and into 2000.

1.3 Repository regulatory framework

In 1999, the regulatory framework for evaluating the suitability of the Yucca Mountain site moved closer to final form. On November 30, 1999, the Department published a proposed revision to its repository siting guidelines. The proposed revised guidelines reflect a shift away from a generic approach that could apply to any site and that focused on individual technical criteria, to a site-specific approach that relies on an overall systems evaluation of the expected performance of a repository at Yucca Mountain. This same approach had been taken by the NRC in the proposed repository licensing regulations it published on February 22, 1999. The Department's siting guidelines must lead to selection of a site that can satisfy the NRC regulation and receive a license. On August 27, 1999, the Environmental Protection Agency (EPA) published proposed radiation protection standards for a repository at Yucca Mountain. The NRC regulation must implement the EPA standards. The NRC has announced that it will, if necessary, revise its regulation once the EPA standard is finalised.

1.4 Repository design

In 1999 work was focused on preparing for a Secretarial determination on site recommendation. It is expected that a Site Recommendation Consideration Report will be released in Fiscal Year 2001. In 1999 the work to develop the Site Recommendation Consideration Report built on the Viability Assessment of a Repository at Yucca Mountain that the Secretary released in December 1998. A major accomplishment in 1999 was the adoption of repository design enhancements for the total system performance assessment that will support the Secretarial determination on site recommendation. Some of the new features had been recommended by the Nuclear Waste Technical Review Board. To be more flexible in meeting changing expectations and to simplify the approach to licensing the repository, the Programme adopted an approach for a "cooler" repository that employs long term ventilation to remove heat from the waste packages. The benefits of this approach include reducing the uncertainties associated with predicting the effects of heat on the natural system along with being able to utilise a single emplacement drift that is representative of the entire repository. This concept allows for repository closure after 50 years or to remain open for as long as 300 years, depending on the results obtained from performance confirmation monitoring and the views of future generations.

Another important task that will support the Site Recommendation Consideration Report was continued development of system description documents for major repository subsystems related to

safety, such as the materials handling system. These documents specify requirements for repository subsystems and describe the resulting design.

1.5 Draft Environmental Impact Statement

On August 6, 1999, the DOE Draft Environmental Impact Statement (DEIS) for a Geologic Repository on Spent Nuclear Fuel and High-Level Radioactive Waste was issued for public comment. The DEIS provides information on the potential environmental impacts that could result from the proposed action to construct, operate and monitor, and eventually close a deep underground repository at Yucca Mountain, in Nye County, Nevada. The DEIS also analyses an alternative to the proposed action: a no-action alternative. The DEIS further analyses the potential impacts of transporting spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site from 77 sites across the United States. The analysis also includes the use of active institutional controls (controlled access, inspection, maintenance, etc.). DOE has held 21 public hearings on the DEIS. The public comment period on the DEIS closed on 28 February 2000. DOE is in the process of reviewing the input and will prepare a Final Environmental Impact Statement in FY 01.

1.6 Scientific Investigations of Yucca Mountain

The Project activities associated with scientific and engineering investigations were focused on the remaining key uncertainties about the Yucca Mountain site. Those uncertainties, discussed in the Viability Assessment, include: the presence and movement of water through the repository block; the effects of water movement on waste package degradation; and the effects of heat from the decay of radioactive materials inside the waste packages on the site's geologic and hydrologic behaviour. The Programme's main thrust in 1999 (and further planned for most of the year 2000) has been to ensure that sufficient data has been obtained to support the Site Recommendation (SR). The current goal is to obtain 80% qualified data required for the SR, and to further obtain 100% qualified data by the License Application.

Construction in the underground Exploratory Studies Facility progressed significantly in the last year. It is expected that work associated with construction of the cross drift alcoves and niches will continue towards completion over the next few years.

The Drift Scale Heater Test in the Thermal Testing Facility is continuing, and conservative analyses of measured and predicted temperatures in the rock mass surrounding the heated drift indicate generally good agreement between measured and predicted values. It is planned that, subsequent to heater operation over the next year, a four year cool down evaluation cycle will be initiated.

C-Well tracer testing of the Prow Pass interval in the saturated zone below the level of the proposed repository is being continued to better characterise the flow, dilution, and sorption potential in the uppermost hydrogeologic unit in the saturated zone immediately downgradient from the potential repository.

Scientists continued working at the Busted Butte where they are studying tracer movement, fluid flow, and transport behaviour in a distal extension of the rock of the Calico Hills Formation, which lies between the repository horizon and the water table. These tests are yielding information that is being used to evaluate how far and how fast key radionuclides may move in the non-welded rock below the repository in the unsaturated zone.

It is expected that, in the year 2000, the project activities will transition from scientific investigations to data synthesis, model validation, repository and waste package design, and safety analysis.

1.7 Waste acceptance, storage and transportation

With funding for this Project at less than 1% of our FY 99 budget, work remained curtailed. We continued to manage the contracts we executed with utilities under the Nuclear Waste Policy Act and to gather the data about their spent fuel inventories that are required for waste acceptance.

Under these contracts, DOE was to start accepting spent nuclear fuel from utilities in 1998. With no Federal facility available to receive the material, utilities continued to pursue litigation to seek relief from hardships they allege as a consequence of the Department's inability to accept waste. In an effort to resolve this dispute, in a March 1999 testimony before Congress, the Secretary proposed that the Department take title to utilities' spent nuclear fuel and manage it at their sites. Analysis of this option is underway.

In October 1999, a successful demonstration of a prototype for a dry transfer system for spent nuclear fuel, which Congress had directed DOE to develop cooperatively with the nuclear utility industry, was concluded. We expect the NRC to approve our Topical Safety Analysis Report on the dry transfer system by April 2000.

1.8 Accelerator transmutation of waste (ATW)

The U.S. Congress directed the DOE, through the Fiscal Year 1999 Energy and Water Appropriations Act, to evaluate the accelerator transmutation of waste (ATW), and by the end of the Fiscal Year 1999 to prepare a road-map for development of this technology.

DOE developed an ATW road-map, including among other tasks: 1) identification of the technical issues that must be resolved, 2) a proposed schedule, and cost estimate for such a programme, including an estimate of the capital and operational life-cycle costs to treat spent fuel, 3) proposed collaborative efforts with other countries and other programmes developing ATW technologies, 4) identification of the institutional challenges, and 5) an assessment of the impact that ATW technology could have on the civilian spent nuclear fuel programme along with identification of development areas that could benefit other ongoing programmes.

A major conclusion of the study is that a repository is an essential element of the nuclear fuel cycle with or without ATW deployment.

A summary of the major recommendations resulting from development of the roadmap includes, but is not limited to: 1) during an initial 6 year trade and systems studies period, science-based R&D should address the key technology system element issues identified during roadmap preparation; and 2) work planned and implemented during this period should be accomplished through robust international collaboration.

2. U.S. Department of Energy / Office of Environmental Management

2.1 Overview

The primary mission of the DOE Environmental Management (EM) programme is to reduce health and safety risks from contamination and waste at the sites associated with the development of nuclear weapons and nuclear power systems. This mission is realised through the following programme areas: waste management; environmental restoration; nuclear material and facility stabilisation; science and technology; pollution prevention, and public accountability. The overall programme is responsible for the storage and treatment (both short and long-term) and disposal nuclear and chemical wastes generated during more than 50 years of nuclear weapons production and nuclear research.

The EM programme currently has responsibility for cleanup of over 113 geographic sites in over 30 states and one territory – over 2 million acres. EM continues to work toward the goal of cleaning up as many of its sites by the year 2006. As of the beginning of FY 00, cleanup had been completed at 69 of these sites, leaving 44 to be completed. Three DOE sites – Rocky Flats, Colorado; Fernald, Ohio; and Miamisburg, Ohio – are pilot sites for accelerated closure.

The number of sites and facilities managed under the EM programme has grown as projects have been transferred from other DOE programmes (such as Defence Programmes and Nuclear Energy). The programme now manages several hundred high-level radioactive waste tanks and thousands of contaminated buildings that remain to be deactivated and decommissioned. The volume of waste managed by DOE is enormous – 36 million cubic meters, containing about one billion curies of radioactivity.

In addition to managing the existing legacy of wastes, materials, and contaminated sites and structures, the prevention of further waste generation and pollution is a major goal of EM and of the Department as a whole. In 1996, and again in 1999, DOE issued aggressive pollution prevention goals in order to reduce generation of hazardous, radioactive, and sanitary wastes by at least 80% by 2010 or earlier (using 1993 as a baseline).

2.2 Waste management

An important part of the EM mission is to protect people and the environment from the hazards of Departmental waste by providing an effective and efficient system that minimises, stores, treats, and disposes of waste as soon as possible. Currently, waste management facilities store and manage more than 700 000 cubic meters of radioactive waste and a wide variety of hazardous chemical wastes at more than 40 sites nationwide. Some 80% of the radioactive waste is also mixed with hazardous chemicals. Much of this waste has been stored at DOE sites for up to 50 years. These wastes include high-level radioactive waste, transuranic waste, and low-level waste. Highlights of progress in managing these wastes are provided below.

High-level waste

The focus of Environmental Management's (EM’s) activities for managing high-level waste is on storage and treatment so that it can be disposed in a geologic repository. (Disposal of this waste, along with spent nuclear fuel, is the responsibility of the Department of Energy's (DOE's) OCRWM – covered in the first section of this paper.) DOE currently manages about 345 000 cubic meters of high-

level waste generated from the reprocessing of spent nuclear fuel at four DOE sites. Most of this inventory is in the form of sludge, liquids, salts, and calcine. The strategy for preparing this waste for ultimate disposal is to vitrify the waste into glass logs. Treatment began in 1996 at vitrification facilities at the Savannah River Site in South Carolina and the West Valley Demonstration Project in New York, two of the four sites that store significant quantities of high-level waste. To date, about 1 000 canisters have been produced (less than 10% of the total number of canisters to be produced at the four sites over their life-cycle). Vitrification at West Valley is nearing completion. Design is underway for a new vitrification facility at the Hanford Site and early planning is underway at the Idaho National Engineering and Environmental Laboratory. Once vitrified, the canisters of high-level waste will remain in storage at the sites that generated the waste until a repository is available.

Transuranic waste

DOE is currently managing more than 100 000 cubic meters of transuranic waste, the bulk of which is at six major sites. The strategy for managing transuranic waste is to dispose of the waste in a geologic repository built in salt deposits. DOE selected this type of disposal for transuranic waste because of the geologic stability of the salt formations, which will safely and permanently isolate transuranic waste for thousands of years. The Waste Isolation Pilot Plant (WIPP) is a series of chambers carved into salt beds 645 meters (2 150 feet) underground, located about 30 miles east of Carlsbad, New Mexico. After two decades of development, WIPP opened for disposal operations in March 1999. During the first six months of operation, WIPP received 32 shipments (containing 276 cubic meters) of transuranic waste from three sites – Los Alamos National Laboratory, Rocky Flats, and Idaho National Engineering and Environmental Laboratory (INEEL). The WIPP disposal capacity is about 175 000 cubic meters, and it will take about 30 years to fill.

More recently (October 1999), the State of New Mexico issued a permit that will allow for mixed transuranic waste (transuranic waste containing hazardous constituents regulated under Resource Conservation and Recovery Act regulations) to be received at WIPP providing the waste meets the WIPP acceptance criteria. Some mixed transuranic waste will require treatment prior to shipment to WIPP. Therefore, the EM programme is working toward providing treatment capacity for this waste. New treatment facilities are planned, with the first new facility – the Advanced Mixed Waste Treatment Project at INEEL – scheduled for operation in 2003.

Low-level and mixed low-level waste

Approximately 1 million cubic meters of low-level waste and 176 000 cubic meters of mixed low-level waste will require disposal over the next twenty years. Currently, DOE has six low-level waste disposal sites. Waste generators without an on-site low-level waste disposal facility ship waste to one of the operating sites for disposal and in some instances to commercial facilities when practical and economical. In February 2000, DOE decided to continue disposal at these sites for wastes generated onsite, while allowing other waste generators to ship their wastes to the disposal facilities located at the Nevada Test Site, NV, and Hanford Site, WA. In addition, DOE decided to dispose of its mixed low-level waste at Nevada Test Site and Hanford Site, where facilities have already been constructed but to date used only for on-site generated waste.

Privatisation of traditional DOE functions

EM has taken steps to transfer functions traditionally performed by the Department's management and operating contractors to private companies that will provide the service on a competitive, fixed-price basis. EM is working to privatise the Hanford Tank Waste Remediation

System – the largest single project at the Department – to reduce the technical and cost-performance burden on the Department. Other privatisation projects include capabilities to store spent nuclear fuel; to treat transuranic and mixed waste at the INEEL; to treat transuranic waste at Oak Ridge, TN; and to transport remote-handled transuranic waste to WIPP.

2.3 Environmental restoration

Another key part of the EM mission is environmental restoration – the remediation and management of contaminated environmental media (e.g., soil, groundwater, sediments) and the decommissioning of facilities and structures at some 113 geographic sites in order to protect human health and the environment from existing risks and provide for future beneficial reuse of restored land and facilities. As of the start of FY 00, 69 of the 113 geographic sites have been cleaned up. Two more will be cleaned up in FY 00 and three more in FY 01. At each geographic site, there may be numerous individual waste sites, referred to as "release sites," and contaminated facilities whose cleanup ultimately leads to completion of an entire geographic site.

Cleanup progress at environmental restoration sites takes the form of "remedial actions," which are actions taken to identify and contain or remove soil and groundwater contamination to prevent it from spreading, to decommission and dismantle facilities, and to clean up contaminated structures. Decommissioning operations range from small cleanup activities involving portions of buildings to complete structural dismantlement.

Since 1989, EM completed cleanup actions at almost half (about 4 300) of the individual release sites (out of a total inventory of 9 700 release sites), and decommissioned about 15% (558) of the facilities that need to be decommissioned (over 3 300). In addition, EM is continuing multiple environmental restoration activities and groundwater effort at all major EM sites.

After completing cleanup, the EM programme will maintain a presence at most sites to monitor, maintain and provide information on any contained residual contamination. These activities are designed to maintain long-term protection of human health and the environment. Such long-term stewardship will include passive or active institutional controls and, often, treatment of contaminated groundwater over a long period of time. The extent of long-term stewardship required at a site will depend on the desired end-state to be reached at that particular site.

2.4 Nuclear materials and facility stabilisation

Stabilising, monitoring, and maintaining the large quantity of nuclear material and spent fuel left over from Cold War weapons activities is one of the most urgent tasks in the EM programme. DOE must stabilise these materials and fuel (i.e., produce a safer chemical and/or physical form of the material) to reduce the level of potential risks, such as exposure to radiation, contamination of people and the environment, and critical events. Stabilisation activities have been prioritised so that the most serious risks are addressed first.

Nuclear materials will be stabilised at the Plutonium Finishing Plant at Richland and in several facilities at the Rocky Flats Environmental Technology Site and the Savannah River Site. DOE's spent nuclear fuel, and the foreign research reactor spent fuel that the U.S. is accepting, will be treated where necessary, packaged suitably for final disposal, and placed in dry interim storage pending disposal in a geologic repository. As nuclear material and spent fuel are placed in more stable

forms, the physical plant (buildings, production systems, machinery, and utilities) where the materials had been stored can be deactivated.

Milestones have been established for the stabilisation of some nuclear materials by the year 2002, including various forms of plutonium, uranium, special isotopes, and spent nuclear fuel. Based on the current inventory of materials and facilities in the programme, it is projected that the stabilisation mission will be complete by 2010.

Throughout FY 99, the EM programme reduced environmental risks by stabilising nuclear and other materials and spent nuclear fuels at the Savannah River Site, plutonium residues and plutonium metals and oxides at Rocky Flats, and materials at several other sites. These materials are located in spent-fuel storage pools, reactor basins, reprocessing canyons, and various facilities once used for processing materials for nuclear weapons. All plutonium pit shipments from Rocky Flats to Pantex Plant were completed in FY 99, and starting in FY 00, the metal/oxide containers will be shipped from Rocky Flats to the Savannah River Site. Plutonium stabilisation activities at Hanford Site's Plutonium Finishing Plant were restarted in FY 99.

The Department currently stores and manages spent nuclear fuel resulting from DOE missions and from domestic and foreign research reactors. This spent fuel, approximately 2 500 metric tons of heavy metal, is currently stored in facilities at four DOE sites – Hanford, INEEL, Savannah River Site, and West Valley Demonstration Project. A geologic disposal facility is not expected to be ready to accept Department-owned spent nuclear fuel before 2015. New dry storage facilities are being developed at Hanford and INEEL to provide long-term storage of spent nuclear fuel and allow ageing facilities to be decommissioned.

The EM programme continues to play a key role in implementing U.S. nuclear weapons non-proliferation policy regarding foreign research reactor spent nuclear fuel. Under this policy, the United States will accept, over a 13-year period, up to approximately 20 metric tons of research reactor spent nuclear fuel from 41 countries. Only spent nuclear fuel containing uranium enriched in the United States falls under this policy. DOE has completed 14 shipments of spent nuclear fuel from foreign research reactors from 23 countries. Twelve shipments have been received at the Savannah River Site in South Carolina. Two shipments to INEEL have been completed, including the first cross-country shipment of foreign research reactor spent nuclear fuel from Savannah River Site in August 1999.

2.5 Science and Technology

EM develops and deploys innovative environmental cleanup technologies that reduce cost, resolve currently intractable problems, and/or are more protective of workers and the environment. Technology development activities are organised in five major focus areas: (1) Mixed Waste; (2) Radioactive Tank Waste; (3) Subsurface Contaminants; (4) Deactivation and Decommissioning; and (5) Nuclear Materials. Crosscutting activities are conducted in support of these focus areas, such as robotics, efficient chemical separations; characterisation, sensors, and monitors; industry and university programmes; and technology integration.

The success of the EM science and technology programme is currently measured by several factors: (1) the number of innovative technology systems demonstrated that meet the performance-specification-based needs identified by Site Technology Co-ordination Groups; (2) number of innovative technology systems ready for implementation with cost and engineering performance data; and (3) number of deployments of innovative technologies in cleanup activities. In FY 99 alone,

27 innovative technologies were demonstrated to meet identified needs; 129 innovative technology deployments were accomplished at DOE sites; and 40 were made ready for implementation.

2.6 Pollution Prevention

DOE's respect for the environment has lead to an aggressive pollution prevention programme, which focuses on reducing or eliminating the creation of pollutants or waste at the source. In 1996, DOE outlined specific goals for reducing waste generation and the use and release of toxic chemicals and for increasing recycling and the purchase of environmentally preferable products. These goals require the complex-wide reduction of routine operations' low-level radioactive, mixed, and hazardous wastes by 50%, and routine operations' sanitary waste by 33%, compared to the 1993 baseline. Within two years, DOE sites implemented over 1 800 pollution prevention projects and were able to avoid more than 390 000 cubic meters of waste, for a reported cost savings/avoidance of $405 million. Beginning with FY 99, DOE set an aggressive goal for a 10% annual reduction in waste generation from cleanup/stabilisation activities. Sites are recognised for their achievements in pollution prevention through annual awards. Below are some examples of site successes:

- Los Alamos National Laboratory recycled lead and steel material from an accelerator facility, which was earlier thought to be low-level mixed waste due to its origin and lead content. After surveys determined the material was not activated, it was able to be recycled, reducing low-level mixed waste by about 338 cubic meters at a reported cost savings of over $25 million.

- INEEL replaced a hazardous nitric acid cleaning process with an environmentally friendly high pressure water cleaning system, thus eliminating nitrogen oxides emissions and nitric acid safety concerns and reducing hazardous waste by six metric tons, for a reported cost savings of $1 million.

- Oak Ridge personnel conducted radiological surveys at facilities during the deactivation process in order to segregate free-releasable items from activated and contaminated ones and was able to release 515 tons of material. This segregation activity reduced low-level waste by over 460 cubic meters, for reported cost savings of $2.3 million.

2.7 Public Accountability

The EM programme maintains a close working relationship with its various stakeholder communities. The Environmental Management Advisory Board, consisting of individuals representing federal and local environmental agencies, corporations, universities, and other organisations, provides advice as an unofficial "board of directors."

The DOE has established Advisory boards at each site with an EM activity to give the public a forum to express its concerns and recommendations. The boards are composed of local citizens, including representatives from local governments, Indian Tribes, environmental and civic groups, labour organisations, universities, waste management and environmental restoration firms, and other interest groups. Board members recommend options to resolve difficult issues facing the EM programme, including site-specific cleanup criteria, risk assessment, land use, priority setting, management effectiveness, cost-benefit analyses, and strategies for site waste management and disposal facilities.

3. U.S. Nuclear Regulatory Commission

3.1 High-Level Radioactive Waste

Regulatory Development Activities

As directed by the Energy Policy Act of 1992, the Environmental Protection Agency (EPA) contracted with the U.S. National Academy of Science (NAS) to conduct a study and provide recommendations to the EPA on the appropriate technical basis for Yucca Mountain standards. Although the NAS could consider a range of issues, its recommendations were to address:

1) whether a standard based on doses to individuals is reasonable;
2) whether post-closure oversight and active institutional controls can effectively ensure that exposures to individuals will be maintained within acceptable limits; and
3) whether scientifically-supportable probability estimates of human intrusion into a repository over 10 000 years can be made.

The NAS issued its report on 1 August 1995 and EPA issued a proposed rule, 10 CFR Part 197 on 27 August 1999 to set environmental standards for Yucca Mountain. In a letter dated 2 November, 1999 to EPA, the Nuclear Regulatory Commission (NRC) provided comments on the Notice of Proposed Rulemaking, Environmental Radiation Protection Standards for Yucca Mountain, Nevada (64 FR 46976).

On 22 February 1999, NRC published for public comment a proposed regulation for disposal of high-level radioactive waste in a proposed geologic repository at Yucca Mountain, Nevada. The proposed regulation is available from the Nuclear Regulatory Commission's (NRC's) interactive rulemaking web site at http://www.nrc.gov/NRC/rule/html. The NRC proposed rulemaking for 10 CFR Part 63 contains risk-informed, performance-based criteria for both pre-closure operations and post-closure performance of the proposed geologic repository for high-level waste at Yucca Mountain, Nevada. NRC's standard is consistent with recommendations of the National Academy of Sciences and with national and international recommendations for radiation protection standards. Although NRC's draft identifies a standard on which to judge the post-closure performance of the proposed repository, the draft recognises the need for NRC's final rule to be consistent with the final EPA standards when they are promulgated. The public comment period for the proposed rule-making ended on 30 June 1999 (64 FR 24092), and the staff, in preparing the draft final rule, has carefully reviewed and considered more than 700 discrete comments enclosed in about 100 individual letters filed during the public comment period. The final rule is expected to be published in FY 00.

Repository programme activities

Under the provisions of the Nuclear Waste Policy Act of 1982 as amended, DOE is required to do several things in the near future which impact NRC. Among them are: (1) Development of siting guidelines for a geologic repository at Yucca Mountain. NRC will be called upon to review and concur in the DOE siting guidelines. (2) As required under the Nuclear Waste Policy Act of 1982, NRC is currently preparing for its review of the Department of Energy's (DOE's) Site Recommendation Consideration Report to provide preliminary comments, ... concerning the extent to which the at-depth site characterisation analysis and the waste form proposal for such site seem to be sufficient for inclusion in any [license] application.., (3) If Yucca Mountain appears to be suitable as a

site for a geologic repository, DOE is to submit a License Application to NRC in 2002. NRC then has the responsibility of issuing a final decision regarding issuance of a construction authorisation within 3 years with a provision for a 1-year extension.

NRC's entire programme of prelicensing consultation is focused on identifying issues early and providing DOE, prior to license application, the guidance needed to resolve the issues so that DOE can submit a complete and high-quality application that NRC can review and make its decision within this statutory time frame. NRC has several other repository programme activities underway and they include the following:

Viability assessment

Although not an explicit regulatory requirement, NRC reviewed DOE's Viability Assessment in order to provide DOE, Congress, and the public with NRC's views on progress made in development of a complete license application and to identify potential licensing vulnerabilities that could either preclude or pose a major risk to licensing. NRC completed its review of the DOE Viability Assessment and provided comments to DOE in July 1999.

Review of DOE Draft Environmental Impact Statement (DEIS) for Yucca Mountain

The NRC staff has completed the review of DOE's DEIS for Yucca Mountain and comments have been provided to the Commission. NRC will provide DOE with comments on the DEIS before the 28 February 2000 end of the public comment period. In accordance with the Nuclear Waste Policy Act of 1982, NRC's comments on the DEIS are to be included as part of any site recommendation of Yucca Mountain.

Total system performance assessment

NRC staff has continued development of a Total Performance Assessment Code for use in assessing performance of Yucca Mountain. Version 3.2 was issued and peer review was completed this year.

White Paper on model validation

In March 1999, staff from the NRC and Swedish Nuclear Power Inspectorate (SKI) prepared a White Paper on a model validation strategy that can be implemented in a regulatory environment. The document, designated NUREG-1636, should not be viewed as, and is not intended to be formal guidance or as a staff position on this matter. Rather, based on a review of the literature and previous experience in this area, this White Paper presents the views of members of the two organisations regarding how, and to what degree, validation might be accomplished in the models used to estimate the performance of HLW repositories. However, the two organisations may move jointly or individually to develop formal guidance or a staff position on this matter, at a later date.

Development of a standard review plan for Yucca Mountain

NRC staff is working on development of a standard review plan for a license application for Yucca Mountain. The review plan is building on insights derived during formulation of key technical issues (KTIs) and Issue Resolution Status Reports (IRSR).

3.2 Low-level radioactive waste

The regulation of low-level radioactive waste disposal is currently being administered by the States under the NRC Agreement State Programme. The principal on-going NRC activity is finalisation of a Branch Technical Position on a performance assessment methodology for low-level radioactive waste disposal facilities. In 1997, the Branch Technical Position, designated NUREG 1573, was circulated for public comment. At present, the staff is responding to public comments and finalisation of the Branch Technical Position is scheduled in calendar year 2000.

3.3 Nuclear facilities decommissioning

NRC has regulatory and oversight activities for decommissioning which involves safely removing a facility from service and reducing residual radioactivity to a level that permits the property to be released. This action is to be taken by a licensee before termination of the license. Some power reactor licensees have recently decided to shut down their facilities prematurely, before the expiration of the current operating licenses (e.g., Haddam Neck, Maine Yankee, Zion, etc.). These unexpected shutdowns have resulted in additional staff efforts in the areas of decommissioning inspections and in the licensing area to process license amendments and exemptions reducing regulatory requirements to correspond to the reduced risk posed by the permanently shutdown plants. In some cases, non-licensed facilities may also be required to reduce or stabilise contamination before sites are released. This activity comprises NRC's integrated regulation of the decontamination and decommissioning of facilities and sites associated with NRC-licensed activities, including associated research, rulemaking efforts, and the technical interface with the EPA to resolve issues of mutual interest.

In 1997 NRC published a final rule on Radiological Criteria for License Termination (10 CFR Part 20 Subpart E (the License Termination Rule) and currently there are several projects underway to provide guidance on implementation of the rule. They include the following:

Standard Review Plan

NRC is developing a standard review plan for use by NRC staff in reviewing and evaluating plans and information submitted by licensees under the provisions of the License Termination Rule. The Standard Review Plan is to be completed by the end of calendar year 2000.

Regulatory Guide on Demonstrating Compliance with the Radiological Criteria for License Termination (Draft Regulatory Guide 4006).

The regulatory guide is intended for use by licensees to comply with the License Termination Rule. It addresses the release from regulatory control of buildings and soil, but does not pertain to the release of contaminated equipment. It contains sections on dose modelling, methods for conducting final status surveys, ALARA analysis, and license termination under restricted conditions. The public comment period for the guide ended in November 1999 and the current schedule is for revision of the draft Guide based on the comments in calendar year 2000.

Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual

The draft manual of radiological laboratory analytical protocols has been developed as multi-agency guidance for project managers and radioanalytical laboratories. Participants in the draft manual's development include the NRC, the EPA, the U.S. Department of Defence (DoD), the DOE,

the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), and the U.S. Food and Drug Administration (FDA), the Commonwealth of Kentucky, and the State of California The draft manual uses a performance-based approach and will support a wide range of data collection activities including decommissioning of nuclear facilities, remedial and removal actions, characterisation and cleanups, compliance demonstration, environmental monitoring, and waste management activities. The draft manual is undergoing internal review by the participants with a planned completion in May 2000.

DandD screen model

The DanD Screen software is intended to be used as a screening tool for implementation of the technical dose criteria contained in NRC's License Termination Rule (10 CFR Part 20 Subpart E). DandD uses a generic approach in defining radiation exposure scenarios for residual radioactive contamination inside buildings, in soils and in ground water. To provide useful and defensible screening level calculations, the NRC has developed 'reasonably conservative' scenarios, pathway models, and parameter values, and has implemented this in DandD Screen. In the case of DandD, 'reasonably conservative' means that the calculated doses are much more likely to be overestimates of the actual dose rather than accurate estimates or underestimates, but at the same time are not necessarily worst case estimates. As a result, the scenarios and models implemented in DandD Screen are relatively simple. Currently a probabilistic version of DandD is under development and completion is scheduled in calendar year 2000.

RESRAD

The RESRAD (*Res*idual *Rad*ioactive Material) computer code was developed by Argonne National Laboratory for DOE to assist in DOE's decontamination and decommissioning of sites. As part of the development of implementation guidance supporting the License Termination Rule and development of a Standard Review Plan for License Termination, NRC contracted with Argonne National Laboratory to incorporate probability distributions of input parameters and a driver for conducting site-specific probabilistic radiation dose analysis into DOE's version of RESRAD and RESRAD-BUILD. These modules will contain user-friendly features based on a specially designed graphic-user interface. The modules will be tailored to running the RESRAD and RESRAD-BUILD codes to perform site-specific probabilistic dose assessments for supporting decontamination and decommissioning of radioactively contaminated sites due to NRC licensed operations in the past. The codes will be finalised for NRC regulatory applications by November 2000.

Joint NRC-EPA sewage sludge radiological study

Disposal of radioactive material into sewage systems and re-concentration of radioactivity in sewage sludge and incinerator ash became an issue in the 1980s with the discovery of elevated levels of radioactive materials in sewage sludge and incinerator ash at several sewage treatment plants. To address this problem, the NRC changed its regulations in 1991 to further restrict the discharge of radioactive material to sewage systems by NRC and Agreement State licensees. In response to a recommendation of the U.S. General Accounting Office, the NRC and the EPA are sponsoring a study of radionuclide levels in sewage sludge and ash from sewage treatment plants. The study is coordinated by a Federal interagency working group (the Interagency Steering Committee on Radiation Standards, ISCORS). The objectives of this joint NRC/EPA sewage sludge and ash study are to: (1) obtain data on the levels of radioactive material in sludge and ash at sewage treatment plants from across the country; (2) estimate the extent to which radioactive contamination comes from either

NRC and State licensees or from naturally-occurring radioactivity; and (3) support potential rulemaking by NRC or EPA, if appropriate. The full study will involve sampling sludge and incinerator ash at up to 300 sewage treatment plants. The methods to be used for the full study were tested at nine sewage treatment sites. The survey and guidance document for sewage treatment plant operators is scheduled for completion in 2001.

3.4 Uranium recovery programmes

NRC efforts for the uranium recovery programme are governed by the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978. UMTRCA established two programmes to protect public health and the environment: Title I and Title II. The Title I programme established a joint federal/state funded programme for remedial action at abandoned mill tailings sites, with ultimate Federal ownership under license from NRC. Under Title I NRC must evaluate the Department of Energy's (DOE's) designs and concur that DOE's actions meet standards set by the Environmental Protection Agency. For Title I, all surface remedial action was completed in FY99 and only reviews for DOE's groundwater remedial action programme remain.

The Title II programme deals with sites under license to the NRC or Agreement States. Under Title II the NRC has the authority to control radiological and non-radiological hazards and ensure that sites (NRC and Agreement State licensed) meet all applicable standards and requirements during operations and before termination of the license. The staff reviews Title II licensee plans for operation, reclamation, decommissioning, and ground-water corrective action; license applications and renewals; license conditions changes; and annual surety updates. The staff also prepares environmental assessments for certain licensing actions.

4. U.S. Environmental Protection Agency

4.1 WIPP

The Environmental Protection Agency (EPA) certified in May 1998 that the Waste Isolation Pilot Plant (WIPP) will comply with EPA's regulations for disposal of transuranic radioactive waste. Two conditions of the certification call for EPA to inspect and approve DOE transuranic waste sites around the country before they may ship waste to the WIPP for disposal. Specifically, EPA must verify that the characterisation of waste at the sites, including the application of quality assurance to waste characterisation, complies with EPA's regulations and the express commitments contained in DOE's compliance application for the WIPP. Since certification, EPA has approved three sites to ship waste: Los Alamos National Laboratory, Idaho National Engineering and Environmental Laboratory, and the Rocky Flats Environmental Technology Site. As of February 2000, DOE has sent a total of 44 shipments to the WIPP from these sites. In addition to site inspections, EPA has a number of other ongoing regulatory responsibilities. The Agency monitors changes to the WIPP programme in order to verify that the activities described in the compliance application still apply. If DOE alters the programme significantly, EPA will initiate an informal rulemaking to consider the changes. Also, EPA must recertify every 5 years whether the WIPP continues to comply with EPA regulations. The first recertification will be completed in 2004. EPA's authority to regulate the WIPP comes from the 1992 WIPP Land Withdrawal Act (as amended). General disposal standards for transuranic waste are codified at 40 CFR Part 191, and specific performance criteria for the WIPP are codified at 40 CFR Part 194. The conditions of the initial WIPP certification are codified as Appendix A to 40 CFR Part 194.

4.2 Yucca Mountain

The Energy Policy Act of 1992 gave EPA the authority to set the potential deep geologic repository for spent nuclear fuel and high-level radioactive waste. The Act also directed EPA to contract with the National Academy of Sciences (NAS) to provide technical input into the standards. EPA received the report from NAS in 1995. The EPA held public meetings and received public comments on that report. The Agency has since been considering technical issues. In 1999, the Environmental Protection Agency (EPA) proposed the site-specific environmental standards for Yucca Mountain, Nevada, as 40 CFR Part 197, opened a public comment period, and held public hearings in four locations. Approximately 800 individual comments were received. The EPA plans to issue the final standards in 2000.

4.3 Low activity mixed waste

As part of a larger set of EPA initiatives designed to ensure the safe disposal of all radioactive wastes, EPA is considering generally applicable environmental standards for the disposal of commercial low-activity mixed waste. Various facilities, including medical, educational, industrial, and nuclear power plants, generate commercial mixed waste in small amounts. For these facilities, current disposal options are unavailable or prohibitively expensive. EPA is working with the NRC, the licensing agency, to define conditions for safe disposal of some mixed waste – hazardous waste containing extremely low concentrations of radioactivity – in facilities originally designed for non-radioactive hazardous waste.

4.4 Technologically enhanced, naturally occurring radioactive material (TENORM)

EPA is investigating sources of technologically enhanced, naturally occurring radioactive materials (TENORM) and the associated risks from exposure to these materials. In general terms, TENORM is material containing radionuclides that are present naturally in rocks, soils, water, and minerals and that have become concentrated and/or exposed to the accessible environment as a result of human activities such as manufacturing, water treatment, or mining operations. EPA recently compiled existing data on TENORM associated with the copper mining industry in the southwestern United States (EPA Report 402-R-99-002). The Agency is currently developing a report on uranium mining, which will address the volumes, types, and locations of TENORM associated with the industry, as well as risks from reasonable exposure scenarios. EPA is also supporting the U.S. DOE's participation in the NEA Working Group on Environmental Restoration of World Uranium Production Facilities.

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INTERNATIONAL ORGANISATIONS ACTIVITIES

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

1. General

1.1 Joint Convention

The number of Contracting States to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management passed the half-way mark towards the number needed for the Convention to enter into force. A third informal meeting of signatories and other interested States was held in Vienna in October 1999 to develop the rules and guidelines that will govern the review process when the Convention is in force, taking account of the experience gained from the Review Meeting on the Convention on Nuclear Safety. As of the end of February 2000, there were 15 Contracting States (11 of which have operational nuclear power plants) and a total of 40 signatories.

1.2 Contact Expert Group (CEG) for international radioactive waste management projects in the Russian Federation

A Contact Expert Group (CEG) for international co-operation in radioactive waste management with the Russian Federation, established in April 1996 under the auspices of the International Atomic Energy Agency, with the secretariat's duties of the Group being performed by the Agency, continued its operation.

The CEG has held nine meetings so far; the most recent in Berlin, Germany, in November 1999. The major topic of this meeting was the "Strategy for Radwaste and Spent Final Management in the Russian Federation". The completion of a CEG document on this topic is planned for the next meeting in Finland in May 2000.

2. Waste safety

2.1 Overview

The programme on radioactive waste safety focused on the establishment of a comprehensive set of internationally agreed safety standards, with the active involvement of Member States and under the supervision of an international advisory committee. A Safety Requirements publication and a Safety Guide on the near surface disposal of radioactive waste were issued in 1999, as well as two Safety Guides on decommissioning. Several other safety standards, including guidance on the control of discharges, were close to completion. Information on the Waste Safety Standards is

available on the internet at http://www.iaea.org/ns/rasanet/standards/WASSAC.htm. In December, an international symposium was held in Arlington, USA, to address the issue of residual wastes. Advice on specific waste management issues was provided to a number of States, notably those that do not have nuclear power plants and have little infrastructure for managing waste, but need to manage other types of residues, such as those from uranium mining and milling.

2.2 Safety of Disposal Waste

Pressure has continued for international rules to be agreed to facilitate the release of materials from nuclear facilities. The issue is becoming more urgent with the increasing number of nuclear facilities undergoing decommissioning and with the developing trade in materials for recycling, such as metals and concrete. The Agency is in the process of revising its guidance on the governing principles and criteria for release from regulatory control. In a related development, there has been a reaction from steel manufacturers to the threat of radiologically contaminated scrap metal entering the international steel pool. The Agency co-sponsored a workshop with the United Nations Economic Commission for Europe on this subject, involving mainly representatives of industry. The workshop resulted in a plan to develop a code of practice to govern and control radioactive contamination in steel scrap.

With the issue, in 1999, of a Safety Requirements publication on near surface disposal and its supporting Safety Guide on safety assessment, the attention of the Agency's Waste Safety Standards Advisory Committee (WASSAC) turned to the development of safety guidance on the geological disposal of high level radioactive wastes. In its preliminary review of the subject the areas of existing international consensus were identified, as well as those areas in which expert opinion has not yet converged. One issue currently under study concerns the safety implications of providing for the possibility of future retrieval of wastes from underground repositories. An assessment of this question is currently underway by the Agency and preliminary results were reported at a workshop, co-sponsored by the Agency, on the subject of retrievability held near Stockholm in October. The workshop presented an opportunity for an exchange of views between experts and members of the public on the ethical, safety, safeguards and economic aspects of national policies, which are currently being developed, that are aimed at the possible future retrieval of wastes from a repository.

The relevance of the Y2K computer problem for waste management facilities was evaluated and the results were summarised in a guidance document. A workshop was also held to exchange information on the safety measures related to Y2K issues at radioactive waste management and nuclear fuel cycle facilities, focusing on the experience gained, prioritisation of activities, "work-around" strategies and contingency plans. Both the guidance document and the results of the workshop were distributed to all States and made available on the Agency's Internet home page.

The Agency was requested by the Brazilian regulatory organisation to assist in the licensing of a bituminisation facility for operational waste at the Angra-2 nuclear power plant. Through its technical co-operation programme, the Agency despatched an expert team that reviewed the facility and made recommendations to the Brazilian counterpart, especially with regard to the need for a commissioning plan for qualifying the facility and for more extensive planning, giving due consideration to the issue of the eventual disposal of the wastes.

2.3 Safety of dischargeable waste

In response to a request from the Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (London Convention, 1972), a report summarising the history of

worldwide disposals of radioactive waste in the oceans was provided to the 21st Meeting of Contracting Parties to the Convention. The report updates a previous report by including information on the disposals of the former Soviet Union in the Arctic Seas area. It was developed as part of an information system that will eventually include records of all discharges of radioactive materials into the environment, as well as of solid disposals, and of accidents and losses of radioactive materials at sea.

A set of safety documents, which establishes internationally agreed policy and methods for the control of radioactive discharges of radionuclides into the environment is nearing completion. The lead document is a Safety Guide which sets out regulatory principles for the control of discharges; it is supported by a Safety Report which contains a recommended methodology for assessing the radiological impact of the releases of radioactive materials to the atmosphere and to surface waters. The two can be used together to develop quantitative release limits which satisfy current international radiological protection principles. Compliance with these limits should be demonstrated by appropriate source and environmental monitoring programmes, as described in another Safety Guide, which is also nearing completion.

The current guidance on release control is aimed at achieving adequate protection for human beings living in the environment affected by the discharge. However, there are increasing concerns for the environment itself and for protecting non-human species. As a first step towards developing policy in this area a discussion document on protection of the environment from the effects of ionising radiation was issued.

2.4 Safety of Residual Waste

International policies for guiding the rehabilitation of areas and sites affected by radioactive residues are just beginning to emerge. In order to facilitate the development of a consensus on principles and criteria in this area and to disseminate information on national and international experience, the Agency organised a symposium in Arlington, Virginia, USA. Discussions at the symposium revealed, as expected, that there are diverse policies being adopted in affected countries at the present time. The meeting served to initiate the first exchanges on the reasons for these differences in approach. It was noted that, although the principles of the International Commission for Radiological Protection for intervention might be expected to provide the appropriate basis for dealing with contaminated environments, the criteria being adopted in many countries are based on criteria developed for practices. The symposium stressed the need for continuing efforts by the international community to provide clear advice that is based on scientific principles and sound professional judgement.

In a continuation of its programme of assessments of the radiological conditions at sites affected by nuclear weapons testing, work started on the examination of sites in Algeria where weapons were tested by France in the 1960s.

In April, the Government of Kazakhstan decided to permanently shut down the BN-350 fast reactor at Aktau. The Agency was asked to assist in the co-ordination of the decommissioning project and provide technical assistance to support the planning effort. In August, the Agency hosted a co-ordination meeting to identify concerns associated with preparing the facility for long term storage, leading to a clear understanding of the problems involved and the identification of assistance that is already being provided through bilateral agreements.

A fact-finding mission to Tajikistan made a preliminary assessment of the radiological situation in that country. In particular, the mission team focused on evaluating the safety and security

of radiation sources in the context of the existing regulatory system, and the safe handling of radioactive residues from the extensive uranium ore mining and processing activities that took place in the country. A preliminary review of the regulatory infrastructure, regulatory requirements and technical capabilities was also performed.

3. Waste technology

3.1 Handling, processing and storage of radioactive waste

Spent fuel and high level waste are an inevitable residue of the production of electricity by nuclear power. In spite of prevailing advantages of reprocessing, only a limited portion of reprocessable fuel is really reprocessed. In this way, besides classical, well-defined vitrified high-level waste, spent fuel, intended to be disposed of as a waste, becomes more significant. One of the main, still not satisfactorily answered, problems of final disposal of this category of waste is its long time performance in disposal site environment. It is required that the waste forms retain certain desirable properties for the specified period of time. If there are expected alterations in these properties with time, these must be understood and shown not to lead to premature deterioration of the desirable features.

The partial studies to model the behaviour of waste forms and release of radionuclides from them have been realised in many laboratories over the world. Nevertheless, the realisation of a complex study is obviously beyond the abilities and possibilities of most of the individual Member States. Therefore the Agency initiated CRP on “Chemical Durability and Performance Assessment of Spent Fuel and High Level Waste Forms under Simulated Repository Conditions”, to provide access to very valuable information for many laboratories and organisations in Member States. The first meeting was held in November 1999, where the recent achievements of 14 participating laboratories were presented and critically discussed.

One of the fundamental principles of radioactive waste management is waste minimisation, which includes both the reduction of generated waste and the reduction of volumes of waste already generated. Waste minimisation can save money - often substantial amounts - through more efficient use of valuable resources and reduced waste treatment and disposal costs. A technical document was published, “Minimisation of waste from uranium purification, enrichment and fuel fabrication”, which reviewed existing practices and experience gained in the minimisation of waste from the front end of the nuclear fuel cycle. This will provide Member States with the relevant information required when making investment decisions and planning facility improvements. Both waste from operating facilities and from their decommissioning are included in the report.

An important element of waste minimisation is the recycle and reuse of valuable materials from different arisings at nuclear fuel cycle facilities (by-products, spent and abundant process materials, plant components and equipment, etc.), which otherwise are considered as waste. The economic advantages, coupled with reduced environment impact and consideration of full life cycle benefit (global optimisation), provide strong incentives to recycle and reuse options. Recognising the importance of the subject and interest of Member States, a technical document was prepared on “Recycle and reuse of materials from waste streams of nuclear fuel cycle facilities”. The report analyses different recycle and reuse options in relation to different areas of nuclear fuel cycle and different nuclear applications. This will allow the recycle and reuse option to be properly assessed as a part of national, site and plant specific waste management policy.

Radioactive graphite becomes a significant category of waste in connection with the forthcoming decommissioning, in various countries, of an extensive group of graphite-moderated reactors and weapons plutonium production piles. To promote exchange of information and contribute to the definition of the most significant problems, a Seminar on "Nuclear Graphite Disposal" was convened in October 1999 in Manchester in co-operation with the Agency and the British Nuclear Engineering Society. Despite the title, the presentations of more that 60 participants from 11 countries covered all aspects of radioactive graphite waste management. Characterisation and proper management of stored fuel sleeves and other fuel element details were indicated as the most urgent subjects. These components, contaminated usually not only by C-14 and T, but also very often by fission products and transuranium elements, are stored in improper conditions, in open silos, and represent a very serious environmental risk. Another complicated technological problem is the treatment and conditioning of bulk volumes of low-active graphite from reactors moderator and reflector. Among others, promising results of pilot tests of steam reforming, commercially used in the USA for ion exchange resins processing, were presented.

3.2 Radioactive waste disposal

Plans to dispose of high-level and long-lived radioactive wastes in deep geological repositories have raised a number of unique problems, mainly due to the very long time-scales involved. Studies to address these problems continue to be a focus of the IAEA activities, with the view to engender confidence in the geological disposal systems.

A technical report was issued on the "Use of natural analogues to support radionuclide transport models for deep geological repositories for long-lived radioactive wastes", IAEA-TECDOC-1109, October 1999. This report describes the current status of the natural analogue information in evaluating models of transport by groundwater to serve for those who are planning to develop a research programme in this field.

Given that the disposal of low and intermediate level radioactive waste can be implemented immediately after the waste is conditioned, many countries are either in the process of developing disposal facilities or have facilities that are currently in operation. At present, the Agency's programme in this area is focusing on experience gained and further R&D required for improving the concept development, siting, implementation and assessment of the safety of disposal systems. In this context is supported a CRP on "The long term behaviour of low and intermediate level waste packages under repository conditions". The research results were recently presented and reviewed at a Research Co-ordination Meeting where specific issues relevant to waste package testing and performance were also discussed.

A technical document on "Maintenance of records for radioactive waste disposal, addressing issues of relevance for both low/intermediate level and high level waste disposal, was published.

An IAEA International Symposium on "Technologies for the Management of Radioactive Waste from Nuclear Power Plants and Back End Nuclear Fuel Cycle Activities" was held in Taejon, Korea (Rep. of), 30 August-3 September 1999, in co-operation with OECD/NEA, NEI and UNIPEDE. It was attended by representatives of governmental authorities, industry, utilities, waste management organisations, research institutes and regulators, including 312 participants from 32 countries and four international organisations. The Symposium documented that proven technologies exist for managing radioactive wastes in ways that are safe, economical and environmentally sound, and that considerable experience exists with these technologies in many Member States. Over the life of the commercial nuclear industry, technologies for managing operational wastes from nuclear power plants have improved substantially and continue to improve in response to economic and environmental

considerations. More attention to waste minimisation and volume reduction technologies, such as compaction and incineration, have led to substantial reductions in the volumes and radioactivity content of solid wastes. Improvements continue to be made in the technologies for treatment and conditioning of radioactive wastes, to the methods that are used to investigate and select sites for waste disposal, and in the construction and operation of the disposal facilities themselves. The one area that has not yet been implemented is geologic disposal of high-level waste and spent nuclear fuel. A few Member States with large nuclear programmes are making progress in developing concepts and toward siting disposal facilities. The Symposium evidenced that Member States have a variety of options still under consideration for management of high-level waste and spent fuel, including long-term storage of spent fuel, until the preferred disposal option becomes more clear.

Within the framework of its Waste Management Assessment and Technical Review Programme (WATRP), the Agency organised, at the request of the Hungarian Atomic Energy Authority (HAEA), an international peer review of the research on site selection and site suitability of the candidate site for low and intermediate level waste disposal in Hungary. The review assessed the screening process that led to the selection of the Üveghuta area for siting a disposal facility for low and intermediate level waste and of the scientific investigations that have been conducted on the preferred site. The team conducted the review in November 1999 and concluded that the process that led to the selection of the Üveghuta site appeared reasonable and appropriately considered both the Hungarian geology and public acceptance. It concluded that the Üveghuta site appears potentially suitable to develop a safe repository for disposal of low and intermediate level operational and decommissioning wastes from nuclear power generation. The team also made some recommendations for future work.

3.3 Technology and management aspects of decontamination, decommissioning and environmental restoration

A Technical Report (TR) on “Management and Organisational Aspects for the Decommissioning of Large Nuclear Facilities” was completed and is expected to be published sometime in 2000. Together with the availability of needed resources, planning and management of activities are essential factors to ensure safe and cost-effective achievement of decommissioning objectives. As one industrial activity which may have large-scale dimensions in the case of commercial nuclear facilities like nuclear power plants or reprocessing facilities, decommissioning requires early planning, provision of all needed technical resources and a dedicated organisation.

Some Member States continue to have problems of environmental contamination resulting from nuclear accidents, weapons testing activities, poorly managed practices of waste disposal, or man-enhanced concentrations of radioactive substances. Environmental restoration (ER) is needed to ensure return of contaminated land and waters to productive uses without impairing the health and safety of the population. The agency is therefore developing an integrated suite of tasks addressing the wide variety of issues. A Directory of Radioactively Contaminated Sites, started with a questionnaire in 1995, will eventually serve as a clearing-house both for information on sites and the approaches to deal with them. A range of technical and managerial issues has been covered by reports published in 1999. These include reports on Technologies for the Remediation of Radioactively Contaminated Sites, on Technical Options for the Remediation of Groundwaters, and on Compliance Monitoring for Remediated Sites.

In some regions, the environmental impact from uranium mining and milling residues is of particular concern. Mill tailings pose a serious problem owing to their inherent geotechnical and geochemical properties and the, often haphazard, way of their impoundment. A new CRP has been initiated in 1999, which aims at helping to resolve the problem of finding long-term solutions.

3.4 Technical co-operation (TC) activities

Several technical co-operation projects on decommissioning of research reactors came to an end in 19998 or 1999. These consisted of the drafting of decommissioning plans in Latvia, Poland, and Romania. The Georgia project will continue in 2000 and presumably beyond, while follow up projects concentrate on specific issues such as decontamination capabilities and material release (Latvia) or spent fuel management (Poland).

A new TC project is underway with Argentina and is of a conceptual nature. It includes providing guidance and expertise for planning of and creating infrastructures for decommissioning of the large number of nuclear installations existing in that country. As for other TC projects, this one also includes expert missions, provision of fellowships and scientific visits. It basically addresses the needs of the country on a national, rather than plant-specific, scale.

The interregional technical co-operation project INT/4/131 on Sustainable Technologies for Managing Radioactive Waste has the objective to transfer and establish sustainable technologies for the management of radioactive waste in selected Member States, including direct assistance in solving urgent problems. Under this project, the conditioning and safe storage of spent radium sources was carried out in Costa Rica, Jamaica and Peru (using an expert team from Brazil), in Ghana and Tanzania (using an expert team from South Africa), and in China and Pakistan by national teams. The latter team will be used to carry out similar operations in the Asia region. Demonstrations of pre-disposal waste management methods and procedures, including hands-on training of participants, were held in Europe (Istanbul, Turkey), Latin America (Santiago, Chile), in East Asia & Pacific (Manila, Philippines) and the first time in Moscow, Russian Federation, for CEEC and NIS.

The regional technical co-operation project RAF/4/015 is providing the framework for Agency assistance to African Member States in building their radioactive waste management infrastructure. Eighteen countries, members of the AFRA regional co-operation, are receiving this assistance, including expert advice, training and equipment.

Among several regional and national workshops it is worth mentioning the AFRA workshop, on the feasibility of the disposal of spent sealed sources in bore-holes, organised in Pretoria, South Africa, in September 1999.

A regional (Latin America) training course on Management of Radioactive Waste from Nuclear Applications was held in Havana, Cuba, in October 1999.

In 1999, the Waste Technology Section has supported about 40 national and regional technical co-operation projects on different aspects of radioactive waste management.

4. Publications issued in 1999

4.1 Waste Safety

Safety Standards Series WS-G-1.1 Safety assessment for near surface disposal of radioactive waste

Safety Standards Series WS-G-2.1 Decommissioning of nuclear power plants and research reactors

Safety Standards Series WS-GS-G.2.2 Decommissioning of medical, industrial and research facilities

Safety Standards Series WS-R-1 Near-surface disposal of radioactive waste

TECDOC-1068	Application of radiological exclusion and exemption principles to sea disposal
TECDOC-1073	Safety measures to address the year 2000 issue at radioactive waste management facilities
TECDOC-1077	Critical groups and biospheres in the context of radioactive waste disposal
TECDOC-1091	Protection of the environment form the effects of ionising radiation
TECDOC-1105	Inventory of radioactive waste disposals at sea
TECDOC-1111	Report of the international workshop on safety measures to address the year 2000 issue at radioactive waste management and nuclear fuel cycle facilities

4.2 Waste Technology

TRS 391	Hydrogeological investigation of sites for the geological disposal of radioactive waste (February 1999)
TRS 395	State of the art technology for decontamination and dismantling of nuclear facilities (November 1999)
TECDOC-931	Hydrogeological investigations of sites for geological disposal of radioactive waste (January 1999)
TECDOC-1086	Technologies for the remediation of radioactively contaminated sites (June 1999)
TECDOC-1088	Technical options for the remediation of contaminated groundwaters (June 1999)
TECDOC-1097	Maintenance of records for radioactive waste disposal (July 1999)
TECDOC-1096	Review of the factors affecting the selection and implementation of waste management technologies (August 1999)
TECDOC-1115	Minimisation of waste from uranium purification, enrichment and fuel fabrication (October 1999)
TECDOC-1109	Use of natural analogues to support radionuclide transport models for deep geological repositories for long lived radioactive wastes (October 1999)
TECDOC-1118	Compliance monitoring for remediated sites (November 1999)
TECDOC-1124	On-site disposal as a decommissioning strategy. (November 1999)

Nuclear decommissioning – a proposed standardised list of items for costing purposes (jointly with OECD/NEA and EC), OECD/NEA, 1999.

Further information can be obtained from:
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EUROPEAN COMMISSION

The European Commission activities in the field of "*Radioactive Waste Management*" are carried out in two Directorates-General: DG Environment dealing with Radioactive Waste Management Policy, and DG Research dealing with Radioactive Waste Management Research.

The following paper gives an overview about the main activities and achievements.

1. Radioactive waste management policy

In the policy area, a number of activities conducted under the "Plan of Action" for radioactive waste management in the European Union came to fruition.

In September 1999, the Commission adopted a "Recommendation" to the Member States on a "Classification System for Solid Radioactive Waste". This recommendation (SEC(1999)1302 final) is that:

- the Member States and their nuclear industry adopt a common classification scheme for national and international communications purposes;
- the scheme should be used for providing information on such wastes to the public, national and international institutions and other interested organisations.

The scheme is based on, and is very similar to, the one developed by the IAEA. It was developed with the assistance of experts from both Member States and Applicant Countries.

These included the study of the role of Environmental Impact Assessments in the siting of geological repositories. This work concluded with a successful seminar in April 1999 and showed that EIAs have already played an important part in bringing together the many parties with a legitimate interest in the siting of a repository. It clearly illustrated the need to involve the public – especially in the region around a proposed site – from the very earliest stage in the process. The report, which includes a model EIA process for a geological repository, has been published (EUR 19152), may form the basis for a formal Communication.

A second seminar, also in April, covered schemes for financing radioactive waste storage and disposal. The bulk of the published report (EUR 18185) describes the schemes used by agencies and waste collecting organisations in Member States as well as Canada and the USA. It also examines other financing schemes used for non-radioactive waste forms (for example by the chemical and pharmaceutical industry) and the possible consequences of modifications in pricing. It briefly examines the financial advantages of exchange of waste and of "common installations".

Given the relatively high profile of the problems of management of disused sealed sources, it was not surprising that the workshop, held in June to discuss the results of an EC-wide study, was very well attended. The "key recommendation" was that "common objectives should be agreed for the regulatory management and disposal of disused sealed sources. These objectives should be implemented in a flexible way through a Common Code of Practice". The report (EUR 18186 – published recently) includes a number of specific recommendations for consideration both by the EU and individual Member States. Their implementation could result in improvements to regulatory control of sources or disposal arrangements. A formal Communication is being prepared based on this report. Other studies are being undertaken on the management of sealed sources in the Applicant States.

In July, the Commission published a report on *radioactive waste management in the countries of Central and Eastern Europe*. This report (EUR 19154), a more "formal" and updated version of the document produced in 1997, was prepared with the help of experts from all the countries involved. As well as describing the present situation in each of the countries, it identifies a range of existing problems and details some of the international efforts to address these. The work contributes to the Commission's ongoing assessment and monitoring of nuclear safety in the context of enlargement of the Union.

Even further afield, reports published last year on radioactive waste management in Russia included an evaluation of the radiological impact resulting from injection operations in Tomsk-7 and Krasnoyarsk-26 (EUR 18189) and on the management of sealed radioactive sources produced and sold in the Russian Federation (EUR 18191).

A few days ago, the Commission published a general overview of the existing and future requirements for decommissioning nuclear facilities in the Czech Republic, Hungary, Poland, Slovakia and Slovenia. The report (EUR 19155) includes a description of the characteristics and inventory of radioactive waste arising from reactor decommissioning (including an in-depth analysis of four selected installations) and a detailed description, country by country, of the basic requirements for decommissioning including the facilities needed for treatment, conditioning, transportation, storage and disposal of the wastes.

Another report published in 1999 covered an *evaluation of the radiological and economic consequences of decommissioning particle accelerators* (EUR 19151). The report covers an inventory of the decommissioning problem of accelerators in the EU, characterisation of three accelerators and their shielding and an estimation of techniques, costs and waste volumes.

We have just concluded a consultation between the various Commission services on the *decommissioning of nuclear installations in the European Union*. This draft Communication to the Member States and the European Parliament includes a proposed "Code of Conduct" and a list of possible future Community actions. We hope that this Communication will be adopted by the Commission before the end of April.

Finally, there has been considerable interest in the preparation of a new "Plan of Action" for radioactive waste management in the European Union. A proposal for a new Plan had been prepared

with the assistance of the Commission's Advisory Committee (the "ACPM"). However, this has been blocked until after a final decision on the proposed reorganisation of the nuclear safety activities within the Commission. This decision has now been expected for some time.

The unit "Nuclear Safety, Regulation and Radioactive Waste Management" of DG Environment now has its own web site : http://europa.eu.int/comm/environment/nuclear/index.htm.

A number of the reports referenced above can be examined or downloaded through that site.

2. Radioactive waste management research

2.1 Research programmes

2.1.1 Nuclear energy (1998-2002)

The 5th EURATOM Framework programme in the field of "Nuclear Energy" (1998-2002) comprises:

- Two key actions: Controlled Thermonuclear Fusion and Nuclear Fission;
- Generic Research on Radiological Sciences; and
- Support for Research Infrastructure.

The key action "*Nuclear Fission*" aims at enhancing the safety of Europe's nuclear installations, to improve the competitiveness of Europe's industry and to perform a clear move from fundamental research to the problem-solving approach to demonstrate the availability of practical solutions to the outstanding scientific and technical problems and public concerns.

The key action comprises four research areas:

- Operational safety of existing installations.
- Safety of the fuel cycle.
- Safety and efficiency of future systems.
- Radiation protection.

Research activities within the "Safety of the fuel cycle" area aims at developing a sound basis for policy choices on the management and disposal of spent fuel and high-level and long-lived radioactive waste and on decommissioning, and to building a common understanding and consensus on the key issues. Research will focus on:

- Waste and Spent Fuel Management and Disposal.
- Partitioning and Transmutation (P&T).
- Decommissioning of Nuclear Installations.

The specific objectives within "*Waste and Spent Fuel Management and Disposal*" are to develop methods for comparing different waste management strategies, to demonstrate the technical feasibility of geological disposal and improve the scientific basis for the safety assessment and to establish better methods for achieving public confidence and trust.

The objective of "*P&T*" is to provide a basis for evaluating the practicability, on an industrial scale, of partitioning and transmutation for reducing the amount of long-lived radionuclides to be disposed of.

The objective of "*Decommissioning of Nuclear Installations*" is to establish a network that will improve the competitiveness of Europe's decommissioning industry and contribute towards a common understanding of the key issues.

The total budget available for the "***Safety of the fuel cycle"*** area is about 60 M€ for the 5-year period.

Following the deadline for submission of proposals for the "*Nuclear Energy*" programme in October 1999, a total of 36 proposals were selected by the European Commission in the "*Safety of the Fuel Cycle*" area for:

- Waste and spent fuel management and disposal: 23 proposals, proposed funding 19 M€.
- Partitioning and Transmutation: 9 proposals, proposed funding 17 M€.
- Decommissioning of Nuclear Installations: 4 proposals, proposed funding 1.2 M€.

The proposals under negotiation in the sub-area on "**Waste and Spent Fuel Management and Disposal**" are covering research activities devoted to (i) repository technology to test steps in the design, construction and operation of a repository in a URL demonstration of effective sealing and backfill concepts in URL's and assessing of the disturbance zone of rock mass due to repository construction; (ii) performance assessment of repository systems to further develop PA methodologies and strengthening the scientific input basis for models used in PA calculations and evaluation of safety indicators; (iii) long-term behaviour of repository systems to test and assess the different barriers considering in the multi-barrier concept; (iv) public attitudes and involvement to deal with the evaluation of transparency in decision making and communication process of complex issues such as nuclear waste management with the public; and (v) quality checking of waste packages associated with destructive and non-destructive waste assay techniques.

With regard to "Research infrastructure", one project will constitute a forum for pooling and assessing experiences from various URL's, in particular concerning backfilling and sealing systems.

In the sub-area "**Partitioning and Transmutation**", nine proposals are under negotiation. Three proposals are dealing with experimental work on chemical separation of actinides from high-level waste by hydro-metallurgical and pyro-chemical processes. The technological support to transmutation by ADS will be addressed by three projects to investigate nitride fuel irradiation, neutron/proton irradiation damage of a spallation target and to assess the use of lead alloys as a spallation target and a coolant for ADS. Basic studies of transmutation are covered by one project addressing experimental neutronic studies of sub-critical configurations and two projects on nuclear data required for transmutation and ADS engineering design. Studies on the thorium cycle will be pursued with a main emphasis on thorium-plutonium fuel irradiation in an additional project and nuclear data as part of the project on nuclear data for transmutation.

Under the "**Decommissioning of Nuclear Installations**", the Thematic Network on Decommissioning (TND) and the continuation of a common decommissioning data base (EC DB NET-2) shall provide the basis for a co-operation and a transfer of knowledge between research institutions, industry and decommissioning projects within the EU including the associated countries.

The remaining budget foreseen for the calls to be made in the second half of 2000 and 2001 available for projects in the area "*Safety of the fuel cycle*" is about 22 M€.

2.1.2 Nuclear fission safety (1994-1998)

The programme on "*Nuclear Fission Safety*", which includes research on "*reactor safety*", "*radioactive waste management and disposal and decommissioning*" as well as "*radiation protection*" covers in total about 125 projects with an overall budget of 170.5 M€ and will be finalised this year.

In the area of "*Radioactive waste management and disposal*", including research work on "*Partitioning and Transmutation*" (P&T) and "*Decommissioning of nuclear installations*", the Commission is involved in about 60 projects with a financial contribution of about 47 M€ [1]. The topics covered are:

- Safety Aspects of Waste Disposal.
- Field Experiments in Underground Research Facilities.
- Research on Basic Phenomena.
- Partitioning and Transmutation.
- Decommissioning of Nuclear Installations.

Main results of these research topics have been among others, presented and discussed at the 5th European Community Conference on "*Radioactive Waste Management and Disposal and Decommissioning: EURADWASTE '99*", held from 15 to 18 November 1999 in Luxembourg [2].

Some conclusions of the conference, drawn from the two panel discussions on "Radioactive Waste Management in Europe: Challenges and ways forward" and "Research for disposal: between demonstration and implementation" are:

- Postponing decisions to dispose of radioactive waste in deep underground repositories and indefinite surface storage of these wastes would impose great burdens on the organisation of society over very long time-scales while phased deep geological disposal is possible.
- Implementation of P&T would only make sense if it were associated to the continued use of nuclear fission energy beyond the operation of the present generation of nuclear power plants.
- Research should not be brought to an end in areas where there are still major conflicting views among the scientific community.
- It is recommended to demonstrate the feasibility of implementation of disposal concepts in Underground Research Laboratories, this backed up by a continuous support of fundamental research in order to create the conditions for a better perception by the public and decision makers of the need to find solutions for all types of radioactive wastes.

2.2 Achievements under the "Nuclear Fission Safety" programme

2.2.1 Radioactive waste management and disposal

2.2.1.1 Safety aspects of waste disposal

"*Disposal of spent fuel*" has been investigated through the research project on "*Spent Fuel Performance Assessment*" (SPA), which identified differences in the methodological approach and models used and discussed them. Progress was made in various fields involved in the study, namely

with regard to the various "*source term models*" adopted by the participants, engineered barrier behaviour, possible effects of an Excavation Damage Zone (EDZ), radionuclide transport in the far-field (clay, crystalline rocks and salt formation) through an update in data review and modelling capability, scenario and biosphere definition, deterministic and probabilistic calculation methods.

A Concerted Action on "*The retrievability of long-lived radioactive waste in deep underground repositories*" in which experts from nine European countries collaborated in reviewing the current understanding and different views of retrievability led (i) to an overview of how the different countries are considering the issue, (ii) to establish an interpretation and working definition of the retrievability concept, (iii) to a methodology allowing the assessment of how retrievability varies between different disposal concepts and (iv) to identify implications on repository design and technology, safety, socio-political, monitoring and safeguards aspects.

2.2.1.2 Field experiments in underground research laboratories

Large field experiments were carried out in three URL's: in the HADES facility in Boom clay at Mol (B), in the Asse salt mine (D) and in the Grimsel Felslabor in crystalline rock (CH), respectively.

These experiments mainly contributed to:

- Repository construction to investigate the "Excavation Disturbance Zone" (EDZ), due to mechanical excavation of a gallery in the Boom clay at Mol and to test the predictive capacity of hydro-mechanical computer models (CLIPEX project)
- Backfilling and sealing of waste emplacement holes, galleries and shafts investigated through:
  - the RESEAL project, carried out in the HADES-URL, demonstrates the effective sealing of a shaft with a high-density pellet/powder mixture;
  - the FEBEX project investigated the suitability of highly compacted bentonite blocks for the backfilling of waste emplacement galleries and demonstrated the successful fabrication, handling and emplacement of the blocks in the Grimsel Felslabor;
  - the BAMBUS project, performed in the Asse salt mine, investigated the behaviour of crushed salt in both the gallery (TSDE) and the borehole emplacement concept, which gave a large amount of data on the performance of backfill and host rock under conditions almost equal to those to be expected in a repository;
- Behaviour of repository components, i.e. the waste matrix, the canister and over-pack materials, the buffer material and the argillaceous host rock under the influence of heat and radiation, has been the objective of the project CERBERUS, performed in the HADES-URL.

The large field experiments performed in Underground Research Laboratories have contributed to demonstrate the technical feasibility of backfilling and sealing emplacement holes and galleries and have extended the technical and scientific database necessary for the safety case. The experimental data obtained, under as near as possible to representative disposal conditions, has permitted to increase confidence in the predicting capabilities of models.

International co-operation and partnerships in research projects carried out in the URL's and the exchange of information were stimulated via the establishment by the European Commission of a *CL*ub of *U*nderground *S*torage, *TE*sting and *R*esearch facilities (CLUSTER – URL's) in which, apart

from the above-mentioned three URL's, the Äspö HRL (S) and the Tournemire research facility in hard clay in Southern France were also represented. CLUSTER-URL meetings and two workshops were held respectively in Alden-Biesen (B) in December 1997 [3] and in Brussels in November 1998. At the last workshop, the Yucca Mountain project (USA) and the Mt. Terri Tunnel project (CH) were presented as well. Moreover, representatives from EU applicant countries planning to build an URL were participating.

2.2.1.3 Research on basic phenomena

Under this research topic, a number of international projects has been supported, which have contributed considerably to extend the scientific knowledge and data base on some important processes and parameters to characterise in qualitative and quantitative terms – where possible – the engineered barrier (waste matrix, canister, overpack, buffer/backfill), geo-mechanical behaviour of natural clay and bentonite, gas generation and migration and radionuclide transport/retardation processes to assess the confinement (near-field/far-field) properties of the multi-barrier components.

The investigations of the behaviour of the engineered barrier components led to some important achievements with regard to:

- Improved modelling of dissolution behaviour of vitrified HLW glass as basis to develop a source-term model used in PA calculations.
- Quantification of rates of spent fuel matrix dissolution under various laboratory conditions (groundwater composition, redox conditions, etc.).
- More reliable database for modelling corrosion behaviour of metal containers (e.g. Ti 99.8 Pd, TStE 355 carbon steel).
- Improved reliability in the experimental data base on the behaviour of bentonites and crushed salt as backfill and sealing materials for boreholes and galleries.
- Increased confidence in modelling the THM behaviour of argillaceous buffer/backfill materials.

The theoretical studies, laboratory and field experiments as well as natural system (analogue) investigations at various sites contributed further to an improved understanding of some of the process occurring in various geological environments (fractured and porous media) and provided also a solid database for application in PA calculations.

Achievements have been obtained with respect to:

- Testing different methodologies and models used in assessing interactive processes of complex natural systems.
- Integration of repository performance requirements from an early stage of the investigation (Oklo, Palmottu site).
- Improved understanding of how past evolution of groundwater systems are being developed and evaluated at a number of European study sites (PHYMOL: Mol site, B; EQUIP: Olkiluoto, FIN; Aspö, S; Vienne, F; Sellafield, UK; PAGEPA: Aspö, S; Gorleben, D).
- Improved understanding of the physico-chemical processes and conditions on colloid facilitated RN migration (CARESS, HUMICS, TRANCOM-CLAY).
- Review ongoing thermodynamic database activities (JETDEM) identified issues where the knowledge base is insufficient: aspects of actinide chemistry, redox transformation, sorption processes etc.

- Assessment of gas generation from waste packages and gas migration through engineered and natural barriers based on laboratory, field experiments and modelling (PEGASUS-cluster) [4].
- State-of-the-art report on the gas issue and its impact on repository performance (in co-operation with OECD-NEA) [5].

Quality Control (QC) and assurance procedures and techniques of nuclear waste packages have contributed to improvement in the accuracy of methods for non-destructive and destructive assay techniques for radioactive waste packages (L/ILW) and to inter-comparison tests contributed to reduce discrepancies in the methods and techniques used, uncertainties in the measurement of nuclide inventory in packages and formulated recommendations for "best practice" in use of assay techniques

2.2.2 Partitioning and transmutation

The research on "*Partitioning and Transmutation*" involves strategy studies, partitioning experimental work and transmutation experiments.

The progress achieved in the field of partitioning of minor actinides by aqueous processes (both experiment and modelling) suggests that it might be possible, in a near future, to develop a process with a single cycle allowing the direct extraction of the minor actinides from the very acidic high level liquid waste.

The conclusions of the P&T strategy studies concerning critical and sub-critical reactors and the results obtained in the transmutation experiments clearly indicate that the ADS have a large potential for the transmutation of nuclear waste, which has to be more thoroughly investigated. In particular, neutronics studies indicate that fast spectrum and liquid lead (or lead/bismuth) cooled, solid fuel ADS have a very large neutron surplus, which should be used for transmutation purposes. In addition, the direct experimental observation of Adiabatic Resonance Crossing demonstrates the possibility of destroying, in a parasitic mode, outside the Energy Amplifier core, large amounts of ^{99}Tc or ^{129}I at a rate exceeding the production rate.

The thorium cycles were re-assessed as a nuclear waste management option. As compared to the uranium fuel cycle, the waste radiotoxicity is strongly reduced (by about one order of magnitude) up to 10 000 to 50 000 years of disposal depending on the reactor type and whether the fuel is recycled or not. Thorium-assisted plutonium burning in a LWR is an attractive option with respect to mass reduction of plutonium, which could be about twice that of MOX in a 100% core loading.

2.2.3 Decommissioning of Nuclear Installations

Research on "*Decommissioning of Nuclear Installations*" contributed to further develop selected innovative dismantling techniques, to collect and analyse relevant data from current projects as well as to evaluate decommissioning strategies.

Development and testing of innovative cutting techniques (laser, plasma-arc, water-jet) were achieved, as well as a successful continuation of the co-operation with the four decommissioning pilot projects: WAGR (gas-cooled reactor), KRB-A (BWR), BR3 (PWR) and KGR (VVER), which started already in FP3 (1990-1994), and led to a huge amount of specific data and experience to be used in various decommissioning projects [6].

A common list of standardised decommissioning cost item definitions to ease a world-wide comparability and transferability of data and costs has been created together with the IAEA and the OECD/NEA.

The EC data bases TOOL and COST were implemented and started the collection and processing technical performance data, waste arising, doses and associated costs. Development of strategic and management planning tools for the decision-making and preparation of decommissioning projects has been dealt with in two projects [7].

As the technology in the field of *Decommissioning of Nuclear Installations*, after 20 years of EC-supported research, has achieved an industrial standard, future activities will be concentrating mainly to support "networks" on information exchange, data collection and training activities.

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OECD NUCLEAR ENERGY AGENCY (NEA)

1. Highlights of activities

Radioactive Waste Management Committee (RWMC)

Mission

- To assist Member countries in developing safe management strategies and technologies for spent fuel, long-lived waste and waste from the decommissioning of nuclear facilities.

Highlights

- An RWMC study reviewed the developments in the area of geologic disposal over the last decade. The study found that the technology is mature enough for deployment, but that progress still needs to be made in building confidence and addressing the ethical and political dimensions of the issue.

- Integrated performance assessments (IPA) are at the core of the safety case. The RWMC analysed experience from regulators' reviews of IPAs, conducted in eight countries.

- Gas generation from the waste, its accumulation and migration are important safety issues for geologic repositories. A jointly published NEA/EC report analysed the state of the art.

- The NEA completed two peer reviews: one of the Japanese "H-12 study", which forms a major decision-making basis for advancing to the next phase of the Japanese waste management programme, and one of the UK NIREX methodology for assessing the long-term safety of a deep geologic repository. The review of SR 97 by SKB, the Swedish Waste Management Agency, was initiated.

- Strategic areas which will form the focus of the RWMC work in the next few years were identified in a published report entitled "Strategic Areas in Radioactive Waste Management".

Geologic disposal

A major review was completed of recent developments in the field of deep geologic disposal of long-lived radioactive waste. The full report, entitled *Geological Disposal of Radioactive Waste: Review of Developments in the Last Decade*, covers the scientific and technical bases for deep geologic disposal, safety assessment, legal and regulatory developments, and communication with the public. The primary sources of input to the study were the answers to a questionnaire provided by NEA Member countries, as well as by the EC and the IAEA, and evaluations of literature, workshops and reports from Member countries and international organisations. In addition to the full report, a summary report was published under the title *Progress Towards Geologic Disposal of Radioactive Waste: Where Do We Stand?*

Peer Reviews

The Japan Nuclear Cycle Development Institute (JNC) submitted a request to the NEA to organise an international peer review of the just-released "H-12 study". This major R&D study provides a decision-making basis for moving the Japanese waste disposal programme from the present R&D phase to a new phase in which siting and regulatory procedures will be formulated. The NEA review provided input in the areas of geology, repository technology and safety assessment.

The international peer review of the *NIREX Methodology for Scenario and Conceptual Model Development* was also completed during 1999. The primary purpose of the review was to judge whether the NIREX methodology provided an adequate framework to support the building of a future licensing safety case. Another objective was to determine whether the methodology could aid in establishing a better understanding, and, ideally, enhance acceptance of a repository among stakeholders (the scientific community, policy makers and the public). The report is available free of charge from the NEA and it can be downloaded from http://www.nea.fr.

Retrievability

Retrievability of disposed waste and reversibility of decisions in waste disposal are currently being considered in many radioactive waste management programmes worldwide. The concepts span technical, regulatory and ethical issues and it is important that a broadly-based understanding is developed of their strategic value and implications. The RWMC has begun preparing a document intended to provide a comprehensive yet concise overview of the issues concerned.

Integrated performance assessments

In every radioactive waste management programme, integrated performance assessments (IPAs) of radioactive waste repositories are at the core of the safety case. After having evaluated the lessons learnt from the conduct of IPAs, a second study, which analysed IPA review experiences of ten implementers and seven regulatory organisations, was prepared for publication under the title *Regulatory Reviews of Assessments of Deep Geologic Repositories: Lessons Learnt*. In order to draw additional lessons from preparing, presenting and reviewing IPAs, a follow-up project was initiated which will focus on the approaches and arguments used to establish confidence in the overall results of IPAs.

Scenario methodologies

A workshop on scenario development for evaluating the safety of radioactive waste repositories was organised in Madrid, Spain on 10-12 May 1999 to review recent developments and practical experience in scenario methodologies, and to prepare an update of the 1992 report summarising the status in this field, identifying where sufficient methods exist and flagging any outstanding problem areas. Participants discussed methodologies and best practice, based on a questionnaire circulated before the workshop. The report is in preparation for publication in 2000.

Sorption

Sorption is a combination of physical and chemical processes by which the migration of radionuclides in the geosphere can be slowed down under certain conditions. Better understanding of the sorption phenomena in radionuclide migration is important for reducing uncertainties and

increasing confidence in assessments of the performance of waste repositories. The NEA seeks to enhance scientific understanding in this area through its sorption project.

The first phase of the sorption project ran from 1997 to 1998, with a workshop being held in Oxford in May 1997. A report updating relevant information on the use of important parameters describing sorption processes is in preparation.

A second phase of the sorption project was initiated. It will take the form of a benchmarking exercise for the different modelling approaches in use at various waste management organisations. By applying these various approaches in a systematic way to the same measured data, an evaluation of their merits and limitations will be possible, as will recommendations on their use.

Clay Club

Defining the chemical and isotopic composition of groundwater present in argillaceous formations is a crucial part in the assessment of the long-term performance of barriers for waste repository systems in such geological media. The NEA "Clay Club" produced a critical review, for publication in 2000, of the relevant literature on current methods used to extract water and solutes from all types of argillaceous media considered for waste disposal, and on the various approaches to the interpretation of their results. An ongoing initiative is aimed at providing a detailed catalogue of "Features, events and processes" (FEPs) specific to the disposal of long-lived waste in argillaceous formations.

GEOTRAP

The NEA GEOTRAP Project on Radionuclide Migration in Geologic, Heterogeneous Media published the proceedings of its third workshop and held its fourth workshop in Carlsbad, New Mexico in June 1999 at the invitation of the United States Department of Energy (USDOE). While the third workshop addressed the roles of water-conducting features in radionuclide migration, the fourth examined the technical confidence in current models used to calculate site-specific performance assessment. Proceedings of the latter are in preparation. The fifth GEOTRAP workshop will be hosted by SKB in Äspö, Sweden in 2001, and will address the theoretical basis for, and geological evidence of, retention processes in heterogeneous geological media.

Gas generation and migration

A substantive body of multidisciplinary experimental and modelling work related to the potential impacts of gas generation, accumulation and migration on the performance and long-term safety of underground repositories. The recently published joint EC/NEA report, *Gas Migration and Two-Phase Flow through Engineered and Geological Barriers for a Deep Repository for Radioactive Waste*, presents a synthesis of this material, which will help national and international programmes better focus future work. This state-of-the-art report will be complemented by a workshop aimed at examining future requirements for an adequate consideration of the gas issue in safety cases. It will be jointly organised in June 2000 by the NEA, the EC, and ANDRA, the French radioactive waste management organisation. The latter will also host the workshop.

Decommissioning

Together with the RWMC, several NEA committees organised a joint workshop in Rome, Italy, in May 1999 to examine the regulatory aspects of decommissioning nuclear facilities. The workshop was hosted by the Italian National Environmental Protection Agency (ANPA) and identified various issues that require additional dialogue among regulators, implementers and waste handling organisations. Several topics have been identified that will be addressed in a series of cross-committee collaborative projects within the NEA framework. Proceeding will become available in the year 2000.

2. Meetings

The following major meetings were organised :

- 2nd Meeting of the Management Board of the NEA Thermochemical Data Base project, Paris, 18-19 February 1999.
- 2nd Meeting of the RWMC Regulators' Group, Paris, 14 April 1999.
- 32nd Meeting of the NEA Radioactive Waste Management Committee (RWMC), Paris, 15-16 April 1999.
- 2nd Meeting of the FEP Database Core Group, Madrid, Spain, 12 May 1999.
- Joint NEA/IAEA/EC Workshop on the Regulatory Aspects of Decommissioning, Rome, Italy, 19-21 May 1999.
- 9th Meeting of the SEDE Working Group on Measurement and Physical Understanding of Groundwater Flow through Argillaceous Media (Clay Club), Madrid, Spain, 25-28 May 1999.
- 4th Workshop of the GEOTRAP Project : Confidence in Models of Radionuclide Transport for Site-Specific Performance Assessment, Carlsbad NM, USA, 14-17 June 1999.
- 10th Meeting of the Co-ordinating Group on Site Evaluation and Design of Experiment for Radioactive Waste Disposal (SEDE), Braunschweig, Germany, 18-22 October 1999.
- 18th Meeting of the Liaison Committee for the Exchange of Scientific and Technical Information concerning Nuclear Installations Decommissioning Projects, Paris, 19-20 October 1999.
- Meeting of the Working Group on the Integrated Performance Assessment of Deep Repositories (IPAG), Paris, 19 October 1999.
- 15th Meeting of the NEA Performance Assessment Advisory Group (PAAG), Paris, 20-22 October 1999.
- Meeting on Retrievability and Reversibility, Paris, 22-23 November 1999.

3. Publications

The following reports were published:

- A Proposed Standardised List of Items for Costing Purposes Interim Technical Document, 1999.
- Confidence in the Long-term Safety of Deep Geological Repositories, Its Development and Communication, 1999.
- Decontamination Techniques Used in Decommissioning Activities, A Report by the NEA Task Group on Decontamination, 1999.
- Nirex Methodology for Scenario and Conceptual Model Development, An International Assessment, 1999.
- Nuclear Waste Bulletin Update on Waste Management Policies and Programmes, No.13 – December 1998.
- Progress Towards Geologic Disposal of Radioactive Waste : Where do We Stand? An International Assessment, 1999.
- Strategic Areas in Radioactive Waste Management, The Viewpoint and Work Orientations of the NEA Radioactive Waste Management Committee, 1999.

4. Development in the year 2000

4.1 Reorganisation of the RWMC working structure

A process of restructuring within the NEA and the OECD with a significant reduction in the number of standing committees has been taking place in the past few years. This reduction in the number of committees is to be compensated by efficiency gains, e.g. through increased co-operation amongst committees and the utilisation of new technologies for information exchange.

The Radioactive Waste Management Committee (RWMC) will continue to focus on the development, evaluation, and licensing of underground repositories for long-lived radioactive waste, including spent fuel. Emphasis will be placed on technical and non-technical aspects of confidence building, and on ethical and societal aspects of disposal strategies, including their public acceptance. Peer reviews and collective views will be developed to help Member countries addressing technical, political and social issues of radioactive waste management. The management of materials from decommissioning and dismantling of obsolete nuclear installations will receive increased attention.

Three new "working parties" of the RWMC – the IGSC (Integration Group for the Safety Case), the FSC (Forum on Stakeholder Confidence), and the WPDD (Working Party on Decommissioning and Dismantling) – officially start this year and allow the Committee to cover the most important areas identified in the RWMC strategy document. Lead groups in each area are as follows:

IGSC: The process of repository development for long-lived radioactive waste.

WPDD: Management of materials from decommissioning and dismantling.

FSC: Public perception and confidence.

4.2 Strategic areas in the RWMC programme of work 2000/2001

Against the background of experience that has been accumulated in the past few years, a number of broad strategic areas have been identified, which the RWMC is prepared to address in the coming years. These areas include (i) overall waste management strategies, considering their background in sustainable development and economic developments and comparing them with principles applied in non-radioactive waste management; (ii) public perception and confidence; (iii) non-technical and technical aspects of the process of repository development for long-lived radioactive wastes; and (iv) the management from materials from decommissioning and dismantling, including very low level waste. To concentrate its competencies and to efficiently work in highly specialised areas, the RWMC has created three working parties to address technical safety issues, public acceptance, and decommissioning issues, respectively.

Within these strategic areas, working on the following activities will provide the most timely and beneficial advances for national waste management programmes.

Waste management strategies and policies

In this field, the RWMC will continue to review progress in the implementation of waste disposal strategies and policies, and to assist Member countries in defining harmonised views on technical and non-technical aspects of waste management. Approaches applied to management of non-radioactive wastes will also be taken into account. For the management of long-lived radioactive waste, the RWMC will carefully assess the potential of specific variations of geologic disposal, including retrievability, extended storage and partitioning and transmutation. Ethical considerations as well as aspects of sustainable development will be part of these considerations. The regulatory systems, which Member countries have set up as a framework for the implementation of geologic disposal of long-lived waste, will be analysed to better understand differences seen in nationally applied safety criteria. Further work will be devoted to the various aspects of a step-wise decision-making process in geologic disposal, and its development and management by regulators, implementers and other involved parties. On request of Member countries, international peer reviews will be organised on major milestones achieved in the national waste management programmes.

Confidence building in waste disposal

In recent years it has become more and more evident that decisions in geologic disposal will require a thorough public dialogue, including the involvement of relevant stakeholders such as waste management agencies, safety authorities, local communities, elected representatives and technical intermediaries. Since the decision-making process and stakeholder involvement avenues differ from country to country, it is important to identify similarities and differences, to understand the key concerns of various stakeholders, and to develop means to interact effectively with the different audiences. To analyse today's processes for embedding waste management programmes into a socio-political decision-making context, the RWMC will compile and analyse successful and unsuccessful experiences in interacting with stakeholders. Factual information and experiences related both to outreach programmes and to public inquiries will be reviewed, drawing out and examining generic elements that are required to ensure and maintain the credibility of waste management organisations.

The process of confidence building for the purpose of repository development and, within this, the role of safety assessments will be studied. This involves documentation of approaches for safety assessment and communication of the safety case to the technical and non-technical

communities as well as, in a broad sense, the treatment of uncertainties. The fundamental boundary conditions for technical safety statements will be analysed and the potential of broader scientific reasoning to enhance confidence, e.g. long-term evolution of the geosphere natural analogues, will be explored.

Special aspects of long-term safety and their integration into a safety case

This activity will involve exchange of information and experience related to national programmes in the form of specific studies and state-of-the-art assessments. The objective will be to facilitate a common understanding of the main elements contributing to long-term safety and their integration into a safety case for geologic disposal. Developments are anticipated in the areas of multi-phase flow in geological formations (the GEOTRAP project), of the assessment and role of engineered barriers systems, and in the definition and application of scenarios for safety assessment. This activity will also include work on the measurement and understanding of the physical aspects of groundwater flow through argillaceous media (the "Clay Club"), which is aimed at assessing the potential of clay formations for geological barriers

Decommissioning of nuclear facilities and management of very low level waste

Decommissioning and dismantling of nuclear installations raise specific considerations for waste management, regarding the potentially large amounts of very low activity materials that arise from this process. Characterisation of these materials, along with strategies for its management, will require increased attention as the volumes of waste that may be generated could make disposal in a repository designed for more active waste impractical. This will also include the definition of environmentally sound and economically acceptable disposal strategies and techniques for other waste contaminated at very low levels, notably in relation to disposal policies with respect to other types of hazardous waste. The timing of dismantling is an important strategic issue, and there is also a need to balance the risks associated with re-use of materials used in nuclear applications, with the cost of treatment and disposal of such materials and potentially with the costs involved with providing new materials from natural resources. Increased attention will also be given to institutional and regulatory issues in decommissioning and dismantling, and other broader, cross-cutting aspects of decommissioning identified in the context of the NEA's programme in this area.

The RWMC will continue to support the NEA Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects under the terms of the Agreement extended until the year 2005, which will continue to review state-of-the-art in all technical aspects of decommissioning and dismantling.

Technical and scientific studies – databases

The RWMC will co-ordinate national and international efforts to acquire and compile data and information and to supply harmonised data sets, models and procedures for the use of waste management organisations in preparing safety cases for geological disposal. The bases of this activity are scientific and technical studies, including benchmark tests of models and data to insure high quality. This activity will include elaboration and maintenance of data bases: the NEA Data Base on Features, Events and Processes (FEPs) and its counterpart for argillaceous media (FEPCAT); the thermochemical database (TDB); and the sorption modelling project. The biosphere project establishes, in close co-operation with the IAEA, an efficient tool to simplify the uncertainty analysis in performance assessment. The TDB project is administered by the Data Bank.

4.3 The IGSC and its programme of work

4.3.1 IGSC

There has been a smooth transition from two very successful groups, PAAG (Performance Assessment Advisory Group) and SEDE (Site Evaluation and Design of Experiments Group), to a single one, the IGSC. A special group, the Bureau-Chairmen group, was convened to help achieve this transition.

The members of the IGSC are composed of senior technical specialists knowledgeable in the assembling or review of the safety case of deep geologic disposal projects within waste management agencies, regulatory authorities, and other relevant institutions. The level of seniority of the IGSC members is such that they can mobilise all relevant specialists in their own organisation and, in principle, can make resources available to the IGSC initiatives.

The official launching of the IGSC took place on 14-16 June, 2000 with a workshop meant (i) to acquaint the members of the new group with one another, (ii) to discuss the group's mandate and (iii) to identify work priorities and a modus operandi.

A classification scheme is used into which previous initiatives and future ones should be organised. The main criteria for the classification are: technical content, level of support in the Member countries, level of support available from the Secretariat. Each initiative should fall in one of three categories – Core Activity, Technical Activity, Co-operation Project – defined as follows:

Core Activity:

- Centre of IGSC work. It promotes an integrated safety case.
- Majority of IGSC members make direct use of the product.
- Results directly support high-level RWMC analyses.
- The Secretariat assures full support.

Technical Activity:

- IGSC closely follows the conduct of the activity. The activity enhances the technical and scientific basis to support integrated safety cases.
- Majority of IGSC members make direct use of the product.
- RWMC is informed of, and analyses, results.
- Shared support amongst Secretariat and IGSC organisations.

Co-operation Project.

- Highly specialised activities in which not necessarily all countries are interested.
- Financed/administered directly by the members of the project, with very direct support by Secretariat.
- IGSC gives guidance and promotes participation.
- RWMC is informed about objectives and results.

4.3.2 Activities under the IGSC

The IGSC members agreed to promote the following activities with their status:

Description of Activity	Category	Status
Development of the Safety Case	Core Activity	The running, central issue for all IGSC work
Integrated PAs (IPAG)	Core Activity	Two phases finalised. Ongoing third phase: confidence building in PAs
Radionuclide Transport (GEOTRAP)	Technical Activity	Proceedings of GEOTRAP IV: available by November 2000. GEOTRAP V to be held early in 2001 provided agreement on that at annual IGSC meeting in November 2000 Synthesis of the work so far within GEOTRAP to be prepared in order to provide a basis for decision on future work
Geosphere Stability	Core Activity	Mandate needs to be defined and proposed to the IGSC at November 2000 meeting
Role of Biosphere		IGSC will receive a report on international initiatives with a view to consider own Technical Activities
Scenario Development	Technical Activity	IGSC will review a completed report on the Madrid workshop in November 2000 and will define further initiatives as necessary
FEP Database	Co-operation Project	Will be available on CD-ROM by 2001
Thermodynamic Database (TDB)	Co-operation Project	Work on phase II will be completed by March 2001
Sorption Forum	Co-operation Project	Phase II is about to start
Clay Club	Co-operation Project	Ongoing
Gas migration	Technical activity	Report on the outcomes of the Gas Migration Workshop to be received. Afterwards consider the priority of any issues identified for more work
Performance of the Engineered Barrier System		Receive an enhanced proposal concerning future work at annual meeting in November 2000
Monitoring and Retrievability (M&R)		IGSC will communicate its readiness for technical activity if this is required by RWMC

4.4 FSC

The Forum on Stakeholder Confidence (FSC)

At the 32nd meeting of the RWMC there was an in-depth discussion regarding the desirability, working programme and start-up of the FSC. It was found that:

- The issue is pertinent now to most programmes
- Start-up with a workshop which will be the basis for defining a 3 year programme
- Priority is to learn lessons from the experience of outreach activities by organisations represented at RWMC
- Broadening the FSC to include external groups should be considered at a later stage.

The start-up workshop of the FSC took place from 28-31 August 2000 in Paris. This forum, the first of its type world-wide, has been set up to facilitate the sharing of Member country experience in addressing the societal dimension of radioactive waste management, to explore means to ensure an effective dialogue with the public, and consider ways to strengthen confidence in decision-making processes. Its establishment reflects a growing recognition of the importance of the social dimension of radioactive waste management. Five main topics have been addressed through invited lectures, overview of the indications from the Member countries, and working group discussions:

1. The changed environment for RWM organisations
2. "Stakeholders" and "the public" – who are they?
3. Is there a new dynamics of communication?
4. Trust and mistrust in organisations
5. Are the waste management organisations set-up for achieving public confidence?

The meeting brought together government nominated participants as well as a considerable number of stakeholders, including academics, sociologists, representatives of mediation and review groups, and elected political representatives, to take stock of the experience of different national waste management programmes in the area of public perception and stakeholder confidence. Proceedings have been published.

The FSC group will meet again in January 2001.

4.5 WPDD

The Group on decommissioning

Based on decisions taken at the 30th meeting of the RWMC, the working party on Management of Materials from Decommissioning (WPDD) is installed as the RWMC's main support group to keep under review the policy, strategic, and regulatory aspects of decommissioning and dismantling of obsolete nuclear installations.

The WPDD is constituted of senior representatives of national organisations who, in their capacity of regulators, implementers, R&D experts or policy makers, have responsibility, broad overview and experience in the field of decommissioning and dismantling. The industrial experience of the CPD is represented by the membership of the Communication group of the LC-CPD. Because of the particular importance of radiation protection issues (e.g. clearance, exemption), CRPPH is invited to nominate additional Members. Participation of RWMC and CRPPH members in the WPDD is considered a good means to enhance the co-ordination of the work of the WPDD with that of the RWMC and CRPPH.

The WPDD has been set into force by the 33rd RWMC on 9-10 March 2000.

The NEA decommissioning issues paper

After the workshop held in Rome on 19-21 May, 1999, a NEA decommissioning issue paper had been prepared. The identified main issues are:

- Decommissioning Policy and Strategy.
- Waste Management and Materials Reuse Considerations.
- Authorised Release of Sites and Facilities.
- Securing Long-Term Funding and Responsibility.
- Safety Regulatory Framework:
  – safety regulation
  – human factors considerations

Based on this paper the NEA committees will identify the work to be undertaken in the future as well as co-operation initiatives.

The Co-operative Programme on Decommissioning

The CPD extended its working agreement for a fourth 5 year period, i.e. through the year 2005.

In order to enable international comparisons of decommissioning costs, a standardised list of decommissioning cost items with definitions had been produced, on the initiative of the CPD, jointly by the NEA, IAEA and the EC. The document, which is supported also by the USDOE, the US Department of Defence and the USEPA (through the CPD), has been issued on an interim basis for a period of about two years for acquiring experience of its use. Following this period, there will be a workshop for discussion and review.

On the developments in the area of clearance of redundant material from decommissioning, the past year has been characterised by activities in the USA. The NRC has issued a draft NUREG on material release, and the American National Standards Institute (ANSI) has published its surface and volume standards on the same subject. The NRC has also published, and has had public discussions on an issues paper. The latter includes the proposal of using the 100 μSv/a individual dose criterion, used

in the EPA exemption of the use of coal ash in construction concrete, as a benchmark for release regulations in the nuclear industry. Conversely, the IAEA and the EC are establishing uneven standards for radioactivity by having the stringent levels of 10 μSv/a as individual dose criterion for the nuclear industry, and allowing up to 1000 μSv/a for the much larger amounts of radioactive material being released from non-nuclear industries producing TENORM (Technically Enhanced Naturally Occurring Radioactive Materials). This is an important issue to take up in within future NEA initiatives.

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GLOSSARY OF ACRONYMS

Acronym	Description
ACPM	Advisory Committee for Programme Management (EC)
AEC	Atomic Energy Commission (Japan)
AECB	Atomic Energy Control Board
AECL	Atomic Energy of Canada Ltd
ANDRA	Agence nationale pour la gestion des déchets radioactifs
ANSTO	Australian National Science and Technology Organisation
BGR	Bundesamt für Rohstoff (Germany)
BMBF	Federal Ministry for Education and Research (Germany)
BMU	Federal Ministry of the Environment (Germany)
BMWi	Federal Ministry for Economics & Technology (Germany)
BNFL	British Nuclear Fuels Ltd.
CEA	Commissariat à l'energie atomique (France)
CEED	Centre for Economic and Environmental Development (UK)
CEG	Contact Expert Group (Russia)
CERBERUS	Project managed by SCK•CEN
CNSC	Canadian Nuclear Safety Commission
COGEMA	Compagnie générale des matières nucléaires (France)
CORA	Committee on Radioactive Waste Disposal (The Netherlands)
COVRA	Central Organisation for Radioactive Waste (The Netherlands)
CRI	COGEMA Resources Inc. (Canada)
CRP	Co-ordinated Research Project (IAEA)
D&D	Decontamination and Decommissioning
DGD	Deep Geological Disposal
DiP	Decision in Principle
DEIS	Draft Environmental Impact System (United States)
DoD	Department of Defence (United States)
DOE	Department of Energy (United States)
EDZ	Excavation Damage Zone / Excavation Disturbance Zone
EIA	Environmental Impact Assessment
EKRA	Expert group for waste management (Switzerland)
EM	Environmental Management (United States)
ENEA	National Agency for Electric Energy (Italy)
ENEL	Ente Nazionale per l'Energia Elettrica (Italy)
ENRESA	Empresa Nacional de Residuos Radioactivos SA (Spain)
EPA	Environmental Protection Agency (United States)
ER	Environmental Restoration
ERAM	Morsleben ultimate storage site (Germany)
EURATOM	European Atomic Energy Community
FASSET	Framework for Environmental Impact Assessments (Sweden)
FDA	Food and Drug Administration (United States)
FEPs	Features, Events and Processes
FEPCAT	Features, Events, Processes Catalogue
GTS	Grimsel Test Site (NAGRA's underground research facility)
HADES	High Activity Disposal Experimental Site (Belgium)

HAEA	Hungarian Atomic Energy Authority
HIFAR	High Flux Advanced Reactor (Australia)
HRL	Hard Rock Laboratory (Sweden)
INEEL	Idaho National Engineering and Environmental Laboratory (USA)
INER	Institute for Nuclear Energy Research (Taiwan)
JNFL	Japan Nuclear Fuel (Japan)
IAEA	International Atomic Energy Agency
IFE	Institute for Energy Technology (Norway)
IMO	International Maritime Organisation
IGSC	Integration Group for the Safety Case
IPAG	Integrated Performance Assessment of Deep Repositories
IPSN	Institut de protection et sûreté nucléaire (France)
IRE	National Institute for Radio-Elements (Belgium)
JAERI	Japan Atomic Energy Research Institute
JAPCO	Japan Atomic Power Company
JNC	Japan Nuclear Cycle Development Institute
JPDR	Japan Power Demonstration Reactor
JRTF	Japan Reprocessing Test Facility
KAERI	Korea Atomic Energy Research Institue
KEPCO	Korea Electric Power Company
KINS	Korean Institute of Nuclear Safety
L/ILW	Low and intermediate level waste
LLW	Low-level waste
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols
MITI	Ministry of International Trade and Industry (Japan)
MOST	Ministry of Science and Technology (Korea)
MOX	Mixed Oxide
MTU	Metric Tons of Uranium
NAGRA	National corporation for the disposal of radioactive waste (Switzerland)
NAS	National Academy of Science (United States)
NEA	Nuclear Energy Agency
NETEC	Nuclear Environment Technology Institute (Korea)
NHMRC	National Health and Medical Research Council (Australia)
NIST	National Institute of Standards and Technology (United States)
NLA	Nuclear Liability Act (Canada)
NORM	Naturally occurring radioactive materials
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission (United States)
NSC	Nuclear Safety Commission (Japan)
OCRWM	Office of Civilian Radioactive Waste Management (United States)
OMEGA	Options for Making Extra Gains from Actinides and fission products
ONDRAF/NIRAS	Organisme national des déchets radioactifs et des matières fissiles (France)
OPG	Ontario Power Generation (Canada)
OVG	The Magdeburg Higher Administrative Court (Germany)
PAAG	Performance Assessment Advisory Group
PRACLAY	A project managed by SCK•CEN

PSI	Paul Scherrer Insitute – Swiss Federal Research Institute
P-T	Partitioning and Transmutation
QC	Quality Control
RAWRA	Radioactive Waste Repository Authority (Czech Republic)
RESRAD	RESidual RADioactive Material (United States)
RN	Radio Nuclide
RWM	Radioactive Waste Management
RWMC	Radioactive Waste Management Committee
SEDE	Site Evaluation and Design of Experiment for Radioactive Waste Disposal
SF	Spent Fuel
SNF	Spent Nuclear Fuel
SKB	Svensk Kärnsbränslehantering AB (nuclear fuel and waste management company – Sweden)
SKI	State Nuclear Power Inspectorate (Sweden)
SOGIN	Nuclear Facilities Management Company (Italy)
SONS	Nuclear Regulatory Agency (Czech Republic)
SPA	Spent Fuel Performance Assessment (EC)
SR	Site Recommendation
SSI	Statens Strälskyddinstitute (state institute for radiation protection – Sweden)
STA	Science and Technology Agency (Japan)
STUK	Radiation and Nuclear Safety Authority (Finland)
TC	Technical Co-operation
TDB	Thermochemical Database
TENORM	Technologically Enhanced, Naturally Occurring Radioactive Material
THM	Thermal-Hydraulic-Mechanical
TR	Technical Report
TRU	Transuranic
TVO	An Electricity Utility (Finland)
USGS	US Geological Survey (United States)
VLLW	Very low-level waste
WASSAC	Waste Safety Standards Committee
WATRP	Waste Management Assessment and Technical Review Programme
WIPP	Waste Isolation Pilot Plant (United States)
ZWILAG	Interim Storage Facility (Switzerland)