Nuclear Waste

BULLETIN

sur les déchets nucléaires

Update on Waste Management Policies and Programmes

Mise à jour des politiques et des programmes de la gestion des déchets

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NUCLEAR ENERGY AGENCY
AGENCE POUR L'ÉNERGIE NUCLEAIRE

THE OECD NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established in 1957 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 29th April 1972 when Japan became its first non-European full Member. Following the recent membership of the Republic of Korea, the Czech Republic and Hungary, the NEA has now 27 Member countries which include all European Member countries of the OECD, as well as Australia, Canada, Japan, Korea, Mexico and the United States of America. The Commission of the European Communities takes part in the NEA's work and a co-operation agreement has been concluded with the International Atomic Energy Agency.

The general aim of the NEA is to further the development of the peaceful uses of nuclear energy by sponsoring economic, technical, and scientific studies and projects and by increasing the compatibility of the safety and regulatory policies and practices of its Member countries.

L'AGENCE DE L'OCDE POUR L'ÉNERGIE NUCLÉAIRE

L'Agence de l'OCDE pour l'Énergie Nucléaire (AEN) a été créée en 1957 sous le nom d'Agence Européenne pour l'Énergie Nucléaire de l'OECE. Elle a pris sa dénomination actuelle le 20 avril 1972 lorsque le Japon est devenu son premier pays Membre de plein exercice non européen. Suite à l'adhésion récente de la République de Corée, du Mexique, de la République Tchèque et de la Hongrie, l'AEN compte désormais 27 pays Membres comprenant tous les pays européens Membres de l'OCDE, ainsi que l'Australie, le Canada, la Corée, les États-Unis d'Amérique, le Japon et le Mexique. La Commission des Communautés Européennes participe à ses travaux et un accord de coopération a été conclu avec l'Agence Internationale de l'Énergie Atomique.

L'objet de l'Agence est de promouvoir le développement des utilisations pacifiques de l'énergie nucléaire grâce à des études et projets de caractère économique, technique et scientifique, et d'assurer une plus grande compatibilité des politiques et pratiques de sûreté et de réglementation de ses pays membres.

EDITOR'S NOTE

The NEA Nuclear Waste Bulletin has been prepared by the Radiation Protection and Waste Management Division of the OECD Nuclear Energy Agency to provide a means of communication amongst the various technical and policy groups within the waste management community. In particular, it is intended to provide concise information on current radioactive waste management activities, policies and programmes in Member countries and at the NEA. It is also intended that the Bulletin assists in the communication of recent developments in a variety of areas contributing to the development of acceptable technology for the management and disposal of nuclear waste (e.g., performance assessment, in-situ investigations, repository engineering, scientific data bases, regulatory developments, etc.).

For practical purposes, the Bulletin does not include an exhaustive description of national programmes. The reader is therefore invited to go back to the information given in previous bulletins and, if necessary, to contact national correspondents in order to obtain a more complete picture of on-going activities.

NOTE DE LA RÉDACTION

Le Bulletin de l'AEN sur les Déchets Nucléaires a été établi par la Division de la Protection Radiologique et de la Gestion des Déchets Radioactifs de l'Agence pour l'Énergie Nucléaire en vue de faciliter la communication entre les différentes communautés intéressées par les aspects techniques et politiques de la gestion des déchets radioactifs. Son objectif est notamment de passer brièvement en revue les questions d'actualité, les politiques et les programmes en matière de gestion de déchets radioactifs dans les pays Membres et à l'AEN. La publication du Bulletin devrait faciliter la dissémination d'informations sur les événements récents dans les différents domaines contribuant à la mise au point de techniques acceptables pour la gestion et l'évacuation des déchets radioactifs (évaluation des performances, recherches in situ, ingénierie des dépôts, bases de données scientifiques, réglementation, etc.).

Pour des raisons pratiques, le Bulletin ne comporte pas une description exhaustive des programmes nationaux. Les lecteurs sont donc invités, d'une part, à consulter les informations figurant dans les bulletins précédents et, d'autre part, à prendre contact éventuellement avec les correspondants nationaux, afin d'obtenir une vue plus complète des activités en cours.

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I.1.1 Senate Select Committee on the "Dangers of Radioactive Waste"

There is approximately 3,300 cubic metres of low level and short-lived intermediate level radioactive waste stored in Australia, of which about 2000 cubic metres is lightly contaminated soil. The other 1300 cubic metres consists of radioactive waste from research, isotope production, industry and nuclear medicine. Such wastes are currently stored at some 50 temporary storage facilities throughout Australia.

Although this quantity of radioactive waste is small by world standards, it attracts much media attention within Australia. In early 1995, transport of radioactive waste to a temporary storage site in South Australia attracted media attention and public and political interest. As a result, a Parliamentary Senate Select Committee on the "Dangers of Radioactive Waste" was established to inquire into radioactive waste management matters in Australia. The then Government subsequently suspended its study to identify a suitable site for a national near-surface radioactive waste repository.

The Select Committee received submissions from relevant Government Departments, Government science and technology agencies, hospitals, industrial users and environmental groups. Following consideration of the Committee's report the Government is proceeding with the study to identify a site for a national near-surface repository for low level and short-lived intermediate level radioactive waste.

I.1.2 National Radioactive Waste Repository Site Selection Study

The second phase of the site selection process for a national near-surface repository for disposal of Australia's low level and short-lived intermediate level radioactive waste, identified eight potentially suitable regions. The Phase 2 Discussion Paper was released in mid 1994. A report summarising and responding to public comment on the Phase 2 Discussion Paper was released in November 1995.

Phase 3 of the siting study involves identification of one of the eight broad regions identified during Phase 2 for more detailed field investigation to identify a suitable site. A discussion paper identifying the preferred region and reasons for its selection is expected to be released for public comment later this year.

I.1.3 HIFAR Spent Fuel

The Australian Nuclear Science and Technology Organisation (ANSTO) holds some 1600 spent fuel rods from the past 39 years of operation of its nuclear research reactors. Although some spent fuel rods were sent to Dounreay for reprocessing in 1996, unless further action is taken, ANSTO's spent fuel storage facilities will reach capacity in 1998.

The Government is considering options for the long term management of HIFAR spent fuel including shipment of the spent fuel rods to their country of origin, both the UK and United States, and domestic processing involving encapsulation of the resulting wastes in Synroc. Radioactive waste

from reprocessing HIFAR spent fuel at Dounreay and from domestic processing can be classified as long-lived intermediate level waste. Australia already manages waste of this level.

Establishment of a national storage facility for long lived intermediate level waste, including HIFAR spent fuel wastes, is a matter being considered by the Commonwealth/State Consultative Committee on the Management of Radioactive Waste (C/SCC).

The C/SCC was established in 1980 to develop co-ordinated policies for the management of Australia's radioactive waste and comprises representatives from relevant Federal, State and Territory Government agencies.

I .1.4 Synroc Research and Development

Development of the Synroc concept for the immobilisation of high level and long-lived radioactive waste is continuing. The development of Synroc waste forms for the immobilisation of particular waste streams at the Hanford (USA) site is being pursued, and the formation of Synroc by melting continues to be studied.

ANSTO is also participating in the US assessment of the immobilisation option for surplus weapons plutonium through collaboration with Lawrence Livermore National Laboratory (LLNL) which has been assigned the lead role by the US Department of Energy for the assessment and development of the immobilisation technologies. ANSTO is providing specific data and demonstrations of Synroc under control to LLNL.

I .1.5 Analogue Studies in the Alligator Rivers Region

The ASARR Project is an extension of the ARAP (Alligator River Analogue Project) and is focused on understanding the mechanisms retarding the transport of radionuclides. The participants in the ASARR Project are ANSTO, JAERI, KAERI and the USNRC. Within the framework of the overall ASARR goal, the participants are implementing individual project activities.

- The USNRC is extending the surface complexation approach to adsorption modelling from reference mineral phases to natural substrates. The aims include a scientific examination of the controversial concept of in situ sorption coefficients Kd.
- JAERI is attempting to clarify which uranium species are fixed to which minerals in order to understand better the retention mechanism and hence to provide an improved basis for the prediction of uranium retardation.
- KAERI is contributing to:
  - the understanding of the dissolution phenomena of uranium minerals in the natural aquatic system;
  - the correlation between the solubilities and the mineral/water interaction; and
  - the prediction of the migration behaviour of radionuclides in geologic media.
- ANSTO, in addition to contributing to the USNRC Joint Sorption Project is:
  - critically examining the key processes associated with transport modelling; and
  - examining the transferability of the methodology from analogue sites to potential repository sites.
- The Third Joint Technical Committee Meeting was hosted by the USNRC at the USGS, Menlo Park.

- The Organisation GRS Germany, has signalled a firm intention to join ASARR.

Further information can be obtained from: *The Director, External Affairs, ANSTO, Private Mail Bag 1, Menai, NSW 2234, [Tel: +61 (2) 543 3111, Fax: +61 (2) 543 5097].*

I .2 BELGIUM

I .2.1 Nuclear Waste Programme

The Cilva solid low-level waste processing and conditioning facility, located on the site of Belgoprocess in Dessel, was granted the ISO 9001 quality certification.

The facility allowed the following processing performances: 26,5 m^3 went through precompaction and 1.141 m^3 through supercompaction; 139,5 tons of solid waste and 88,5 tons of liquid waste were incinerated; 1.257 drums of 400 1 were cemented and subsequently stored in the interim storage building.

The building for the interim storage of vitrified high-level waste resulting from the reprocessing of Belgian spent fuel by Cogéma in La Hague, was made completely ready to receive the vitrified HLW containers as soon as they will be repatriated. However, the start of this repatriation campaign and the route that will be followed still need to be fixed.

The studies with regard to surface disposal of low-level and short-lived waste led to the presentation of a methodology for the selection of a surface disposal site; this study is being evaluated by a consultative scientific commission, the advice of which is expected in the course of 1997.

As requested by the government, NIRAS/ONDRAF launched the study of alternative solutions for the final and long-term management of radwaste. This study is being conducted under the name "Altsurf" and aims at evaluating and comparing the costs of near-surface disposal, geological disposal and long-term storage. It will be presented to the competent authorities in the course of 1997.

Research in the field of geological disposal of HLW was the Praclay-program progress according to plan: the construction of the 2nd access shaft, the extension of the existing Hades underground laboratory through a third connecting gallery and the construction of the so-called Praclay gallery from the connecting gallery were prepared.

The HAWC-contract (vitrification of high-active waste concentrates from the Karlsruhe nuclear research centre) was officially terminated by the German partner FzK (Forschungszentrum Karlsruhe). This forced Belgoprocess to restructure its company and to proceed to the early retirement of some 79 workers.

As far as the Cassiopée economic interest grouping is concerned, NIRAS/ONDRAF passed over the chairmanship to the Dutch Covra. As from 1 January 1997, NIRAS/ONDRAF will act as general manager of the grouping.

The NIRAS/ONDRAF Isotopolis information centre on the site of Belgoprocess was as successful as the preceding year with 15.000 visitors. The travelling exhibition on radwaste management which NIRAS/ONDRAF introduced last year, was seen at more than 10 different locations all over the country.

Finally, Mr. J.-M. Streydio was appointed chairman of the Board of Directors of NIRAS/ONDRAF in substitution of J.-P. Poncelet who became Belgium's federal minister of defence.

Further information can be obtained from: *Mr. J.-P. Minon, Deputy General Manager, ONDRAF/NIRAS, place Madou 1, Box 24-25, B-1030 Brussels, [Tel: +32 (2) 212 1011, Fax: +32 (2) 218 51 65].*

I .3 CANADA

I .3.1 Policy Framework for Radioactive Waste

In July 1996, the Minister of Natural Resources Canada announced a Policy Framework for Radioactive Waste that will guide Canada's approach to the disposal of nuclear fuel waste, low-level radioactive waste, and uranium mine waste in Canada. The Framework lays out the ground rules and sets the stage for the further development of institutional and financial arrangements to implement disposal 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 radioactive waste producers and owners in order that they meet their operational and funding responsibilities in accordance with approved disposal plans. The Framework recognises that there will be variations in approach in arrangements for the different waste types.

In October 1996, Natural Resources Canada distributed a paper on institutional and financial arrangements to major stakeholders, in the federal and provincial governments as well as waste producers and owners in the uranium and nuclear industry, who have direct responsibilities for the management and disposal of radioactive waste. The intent of the paper is to promote discussion on how the stakeholders would fulfil their responsibilities consistent with the new Policy Framework.

With respect to nuclear fuel waste, no decisions will be made regarding the next steps for the long-term management of nuclear fuel waste in Canada until the Canadian Environmental Assessment Agency (CEAA) Panel has completed the public review of the disposal concept for nuclear fuel waste and provided its report with recommendations to the federal government. Any response by government will only be made after a careful and thorough consideration of the Panel recommendations.

For low-level radioactive waste and uranium mine and mill tailings, the federal government wants to be sure that waste owners and producers have in place the institutional and funding arrangements to ensure that the disposal of these wastes can take place when required.

I .3.2 Nuclear Fuel Waste (High-Level Radioactive Waste)

I .3.2.1 Disposal Concept for Nuclear Fuel Waste

In 1988, the Minister of Energy, Mines and Resources (now Natural Resources Canada) referred the concept of deep geological disposal of nuclear fuel waste developed by AECL to the Minister of the Environment for a public review by an environmental assessment panel. In 1989, the Minister of the Environment appointed a Panel, chaired by Mr. Blair Seaborn, to undertake the public review. In 1990, the Panel appointed a Scientific Review Group to assist them in assessing the technical safety of the disposal concept. In March 1992, the Panel issued guidelines for the preparation of an Environmental Impact Statement (EIS) for the nuclear fuel waste disposal concept to the proponent, AECL. In October 1994, AECL submitted the EIS titled "*Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste*" to the Panel. The Panel distributed the EIS to the Scientific Review Group, expert government departments and agencies as

well as the interested public for a nine-month review. Public hearings on the AECL disposal concept began on March 11, 1996. AECL is the proponent during the public review of the concept.

The public hearings are taking place in 3 phases. Phase I, which ended on May 3, 1996, focused on broad societal issues related to the long-term management of nuclear fuel waste. The issues included those related to: (1) ethical considerations; (2) criteria for safety and acceptability; (3) site selection processes; (4) transportation; (5) aboriginal perspectives; and (6) future generations.

Phase II, the technical hearings on the disposal concept, were completed on November 21, 1996. The hearings focused on the technical aspects of the disposal concept and the AECL case for its safe implementation. Ontario Hydro presented supporting environmental, health and socio-economic evidence to show that the pertinent handling, transportation and disposal activities could be safely undertaken.

The remaining Phase III community hearings begin on January 13, 1997 and are to be completed on March 27, 1997. The hearings, which will be held in the Provinces of Saskatchewan, Manitoba, Ontario, Québec and New Brunswick, will provide the interested public with an opportunity to present opinions and views on the safety and acceptability of the disposal concept. The Panel will present its recommendations on the safety and acceptability of the disposal concept and the next steps for the long-term management of nuclear fuel waste in Canada to the Minister of Natural Resources Canada and the Minister of Environment in late 1997. Consistent with the Policy Framework, Ontario Hydro, the largest producer of nuclear fuel waste, has taken over direction and full funding of R&D and planning activities associated with fuel waste disposal in Canada.

The public hearings has been providing an opportunity for broad participation. Attendance has been averaging about 30 to 100 people from the scientific community, environmental groups, aboriginal interests and interested public. By the end of the hearings, the Panel will have held over 50 hearing days in 18 communities, including 3 aboriginal communities, across Canada.

The International Conference on Deep Geological Disposal of Radioactive Waste was held in Winnipeg, Manitoba, Canada, on September 16-19, 1996. Sponsored by the Canadian Nuclear Society, with co-sponsorship by several international nuclear societies and associations, the conference brought together experts from more than nineteen countries that have or are developing geological disposal technologies. Plenary sessions looked at international trends in geological disposal and views on building confidence in radioactive waste management. Technical papers were presented in the areas of siting and site characterisation, repository engineering, engineered barriers, biosphere modelling and characterisation, environmental and safety assessment, and regulatory issues. The issue of gaining public trust and acceptance as well as the principle of community voluntarism and social issues in siting were discussed at several points throughout the conference.

I .3.3 Low-Level Radioactive Waste

In Canada, low-level radioactive waste is either waste produced on an ongoing basis or is classified as historic waste. Ontario Hydro and AECL are the two largest producers of ongoing 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.

I .3.3.1 Ongoing Wastes

Ontario Hydro produces about 80% of the annual volume of low-level radioactive waste in Canada. To date there has been no pressing need in Ontario Hydro 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. Ontario Hydro has established a multi-disciplinary team to assess a variety of management options for its waste, including working in conjunction with other producers and owners and the federal government, to develop a joint multi-user Canadian disposal facility. The year 2015 is considered an achievable target date for bringing a disposal facility into service.

The other major producer, AECL, has taken the initial steps towards development of disposal facilities for low-level radioactive waste for which it is responsible. AECL is currently in discussions with the federal regulatory agency, the AECB, to license a prototype below-ground concrete vault known as IRUS (Intrusion-Resistant Underground Structure) for relatively short-lived waste.

I .3.3.2 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, Northern Alberta, the Northwest Territories and Surrey in British Columbia.

In 1996, a significant level of progress was made in connection with the two siting initiatives, in Ontario and in British Columbia. The Minister of Natural Resources announced the implementation of the Deep River Project in Ontario in response to the recommendations of the Siting Task Force on Low-Level Radioactive Waste Management in Ontario. The Siting Task Force, in Surrey, British Columbia, reported to the Minister with recommendations for the management of the waste located in that province.

The Deep River Project

An independent, ministerially-appointed Siting Task Force was established in 1988 by the federal government to carry out a voluntary co-operative siting process designed to find, with public acceptance, a site for some 1 million cubic metres of low level radioactive waste located in the Province of Ontario communities of Clarington, Hope Township, Port Hope, and Scarborough. In November 1995, the Task Force issued its final report to the Minister of Natural Resources Canada, having found a community in Deep River, Ontario, willing to host a disposal facility for these wastes under the terms and conditions of a Community Agreement In Principle (CAP). In July 1996, the Minister of Natural Resources Canada announced the federal government's intention to proceed with negotiations to develop a legal agreement establishing the terms and conditions, based on the CAP, under which the Town would agree to host the facility. Negotiations based on CAP ended on December 31, 1996. The federal government is hopeful that negotiations based on a new set of terms and conditions will be under way in 1997.

Radioactive Contamination in Northern Alberta and Northwest Territories (NWT)

Uranium ore, mined in the 1930s, '40s and '50s in Port Radium on Great Bear Lake in the Northwest Territories by the uranium mining company Eldorado, was transported by barges 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. This project is on-going.

Surrey Siting Task Force

The Surrey Siting Task Force was established in 1989 to find, through a co-operative siting process, a disposal site for a small quantity of contaminated soil and niobium slag located in Surrey, British Columbia. In December 1996, the Task Force issued its final report to the Minister of Natural Resources Canada. The report is being reviewed by the federal government.

I .3.4 Uranium Mine and Mill Tailings

In Canada, close to 200 million tonnes of uranium mine and mill tailings have been generated since the mid-1950s. These comprise about two percent of all mine and mill tailings in the country. Most of the existing uranium tailings are located in the provinces of Ontario and Saskatchewan. 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, the general policy in Canada is that the producer pays. The AECB requires that operators provide financial assurances that decommissioning of uranium facilities will take place in a responsible and orderly manner in the short- and long-term. Where a producer or owner 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 of management of abandoned uranium mine tailings was signed between the federal and Ontario governments. Canada and Ontario had been discussing the issue of financial and management responsibilities for abandoned uranium mine tailings since 1984. The MOA 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.

I .3.4.1 Federal Environmental Assessment Reviews

The decommissioning plans for four uranium mine and mill tailings sites in the Elliot Lake area of Ontario were referred by the AECB to the Minister of the Environment for a federal environmental assessment and review. It will be the first time that the decommissioning of uranium tailings will have gone through this process. The three-member Elliot Lake Environmental Assessment Panel conducting the review provided recommendations to the federal government in June 1996. The government is currently considering these recommendations and hopes to respond by Spring 1997.

A review of decommissioning plans for another uranium mine site in the Elliot Lake region was initiated in late 1996. This review will be conducted under the requirements of the new Canadian Environmental Assessment Act in force since 1995.

Further information can be obtained from: *Dr. Colin J. Allan, General Manager, AECL, Whiteshell Laboratories, Pinawa, Manitoba R0E 1L0, [Tel: +1 (204) 753 2685, Fax: +1 (204) 753 2455] and Dr. Peter A. Brown, Director, Radioactive Waste and Radiation,*

Natural Resources, 580 Booth Street, Ottawa, Ontario K1A OE4, Canada, [Tel: +1 (613) 996 2395, Fax: +1 (613) 995 0087].

I .4 FINLAND

I .4.1 Technical R & D Studies, Site Investigations and Safety Considerations for Spent Fuel Disposal Updated

As a consequence of the changes in Nuclear Energy Act, the disposal of all nuclear wastes produced in Finland have to take place in Finland. A new company, Posiva Oy, jointly owned by the two Finnish nuclear utilities started operation in January 1996. This new company takes care of the final disposal of spent fuel from the Finnish NPPs . The last transportation of spent fuel from the Loviisa nuclear power plant to Russia took place in autumn 1996.

The company is in charge of all R&D and other preparatory work for the final disposal of spent fuel in Finland and it presented at the end of 1996 reports describing new technical solutions, site investigations, site-specific repository layouts as well as safety assessments, for scrutiny by the authorities.

Technical development work has continued since the previous updating at the end of 1992 by studies related to technology for transportation, encapsulation and final disposal, the evaluation of alternative disposal concepts and safety aspects during operation in addition to estimation of costs. The basic concept for encapsulation is based on cold processing and use of copper canister with a cast iron insert and a copper mantle. Two different canister variations have been designed; one for the BWR-fuel from Olkiluoto plant and the other for PWR-fuel from Loviisa plant. Both canister types contain 11 fuel elements.

The site investigations during 1993 -1996 for three sites (Romuvaara in Kuhmo, Kivetty in Äänekoski and Olkiluoto in Eurajoki) included following subprograms: 1) the baseline investigations describing the present conditions in the bedrock, 2) the additional characterisation for the acquisition of complementary data, and 3) the investigations for testing the earlier results and hypotheses to build confidence in existing understanding. In the presented reports it is concluded that the results obtained confirm the former views on the properties of the bedrock at each site, and indicate that the safe disposal would be possible to be achieved at every site. In the second stage, 1997-200, the site investigation programme will concentrate to evaluate the sites by analysing and modelling the information gathered. The further characterisation is needed to increase hydrogeochemical information and evaluate the transport of solutes. In addition to previously studied three locations the area of the Loviisa nuclear plant, Hästholmen will be included from 1997 onwards as an additional candidate location in the site investigations aiming at final selection of one site in 2000. During the next four years the emphasis will be on syntheses of the information gathered at the candidate sites, including an assessment of site-specific factors relevant to performance and safety of the planned repository.

The TILA-96 study, a continuation and update of the TVO-92 safety analysis, confirms that the planned system for spent fuel disposal fulfils the proposed safety criteria. Provided that no major disruptive event hits the repository, initially intact copper canisters preserve their integrity for millions of years and no significant amount of radioactive substances will ever escape from the repository. Impacts of potential canister failures have been analysed employing conservative assumptions, models and data. In the case of single canister failures, the results show that the margin to the proposed regulatory criteria is more than three orders of magnitude in the dose rate and more

than four orders of magnitude in the release rates into the biosphere. Even in the extreme cases, where all 1 500 canisters are assumed to be initially defective or to "disappear" simultaneously at 10 000 years in the "worst possible location" in the repository, all the proposed safety criteria would be passed.

When realistic modelling and data are used in the consequence analyses, the results show negligible releases and doses. The most apparent difference between the candidate sites for the spent fuel repository is that Olkiluoto is presently located at the coast of the Baltic Sea, whereas Kivetty and Romuvaara are inland sites lying about 200 metres above the sea level. At the depth of 500 metres, groundwater is brackish or saline in Olkiluoto, whereas it is fresh in Kivetty and Romuvaara. Because of the ongoing postglacial land uplift Olkiluoto, too, is likely to become an inland site after some thousands of years.

The studies of Posiva conclude that no extraordinary characteristics are required from a site in the crystalline bedrock to ensure the long-term safety of a deep repository for spent fuel. Local variability and heterogeneity within the investigation sites are of greater importance than the differences between the general properties of the areas. Attempts at an "objective" ranking of the candidate sites in terms of a quantitative post-closure performance index are not meaningful. There seems to be little prospect to discriminate between inland sites with non-saline groundwater in terms of radio-nuclide transport. The site of the spent fuel repository shall be selected in the year 2000. Characterisation and evaluation of the candidate sites should now emphasise three topics: i) Evaluation of the geological structure and fracturing of the bedrock, ii) Identifying of bedrock volumes, where the repository could be constructed, and their assessment from the construction point of view, iii) Assessment of geochemical conditions (the role of brackish and sulphate-rich, saline, and very saline groundwaters).

Furthermore, during 1996 the additional studies requested by the Ministry of Trade and Industry on the suitability of basic rock types were also reported. The main objective of the published work was to complement the localisation study of the previous report and to evaluate also how other than geological factors should be considered in locating possible areas. In addition, the work included the evaluation of the properties of both mafic and felsic rock types in view of the general role of geosphere for the safety of final disposal. Based on the findings of the report it would in principle be possible to locate a site in this type of rock formations. However, for the candidate sites investigated so far no indicators have emerged hinting that the present rock types would not be suitable. Taking into account that the final stage aiming at the site selection in 2000 is being started, the report concludes that there is no need to increase the number of candidate sites for geological reasons only.

I .4.2 First Versions of National Safety Criteria for Spent Fuel Disposal Issued for Comments

The Finnish Nuclear Energy legislation state that general safety regulations are issued by the Government based on the proposal made by the Finnish Centre for Radiation and Nuclear Safety (STUK), which also issues detailed safety requirements, so called YVL-guides. As the first licensing step, the Decision in Principle Process, may be started within the next three years, STUK has started preparation of a proposal for the general safety regulations. They will cover the operational phase of the encapsulation and disposal facility as well as the post-closure safety of spent fuel disposal. STUK's preliminary ideas for safety criteria have already been known to expert organisations and subsequent to a few drafting-commenting phases, STUK's proposal for general safety regulations is expected to be completed by the end of 1997.

I .4.3 Environmental Impact Evaluation Process for Spent Fuel Repository Siting Commenced at Four Municipalities

In early 1997 Posiva has started the environmental impact assessment process for the spent fuel management and disposal project at four municipalities. According to the present plans Posiva will deliver in autumn 1997 the programme of the environmental impact assessment process for review by the contact authority, Ministry of Trade and Industry, and the residents of the planned host communities in public hearing. The actual environmental impact assessment process including the preparation of the Environmental Impact Statement is anticipated to be completed roughly by the end of 1998.

I .4.4 Status of the Second Repository for LLW/MLW

Imatran Voima Oy (IVO) started the construction of a rock cavern repository for low and medium level waste from the Loviisa nuclear power plant in February 1993. The repository has been excavated at the depth of approx. 110 meters in the bedrock at the island of Hästholmen where the Loviisa power plant is located.

The excavation work, in total about 106 000 m^3, was carried out during 1993-1995. When the transport tunnel had been excavated the work was interrupted for additional rock characterisation at the -110 meter level. During 1996 additional reinforcements have been made and construction and installation work has been finalised.

IVO has submitted the Final Safety Assessment Report (FSAR) including the safety analysis and groundwater flow modelling reports to the Finnish Centre for Radiation and Nuclear Safety (STUK). The application for operating license of the repository has been delivered to the authorities together with the application for the renewal of the operating licenses of the Loviisa NPP at the end of 1996.

Operation of the repository is anticipated to start in 1998 after STUK has reviewed the application and the Government has granted the license. The operation as a disposal facility could thus start in the beginning of 1998. The first stage of the repository comprises the disposal rooms for low level maintenance waste and for solidified low and medium level reactor waste. The utility has obtained a permit from STUK to temporarily operate part of the facility as an interim storage for low level wastes during 1997. In the second phase starting around year 2000, also solidified medium level waste is planned to be emplaced in the repository.

At TVO's power plant at Olkiluoto, the VLJ repository for LLW/MLW has been in operation since 1992.

I .4.5 New Phase (1997-2001) of the Public Sector´s Nuclear Waste Management Research Programme Started

The "Publicly Administrated Nuclear Waste Management Research Programme 1994-1996" funded and supervised by the Ministry of Trade and Industry, and STUK, has been concluded and the final report is going to be published during spring 1997. A new programme phase for the period 1997-2001 has been launched. Societal issues, environmental impact assessment and communication will have an increased weight in the new programme. In addition, the technical and natural science studies concerning the long-term safety are continued.

Further information can be obtained from: *Mr. S.. Vuori, VTT, Energy Tekniikantie 4C, Espoo, P.O. Box 1604, Fin-02044 VTT, Finland, [Tel: 358 (0) 456 5067, Fax: 358 (0) 456 5000, Internet: Seppo.Vuori@vtt.fi].*

I .5 FRANCE

La loi n° 91.1381 du 30 décembre 1991 a donné à l'ANDRA (Agence nationale pour la gestion des déchets radioactifs) son indépendance et son statut d'EPIC (Établissement Public à caractère Industriel et Commercial) et a défini ses missions dans le cadre de la gestion des déchets radioactifs. Les différents points développés ci-dessous reflètent l'activité de l'ANDRA pour l'accomplissement de ses missions.

Les faits marquants de l'année 1996 relèvent des domaines suivants :

- la baisse du volume de déchets stockés sur le Centre de l'Aube et le passage en phase de surveillance du Centre de La Manche,
- le dépôt des dossiers de Demande d'Autorisation d'Implantation et d'Exploitation des laboratoires souterrains pour chacun des trois sites envisagés,
- la publication de l'édition 96 de l'inventaire national des déchets radioactifs établi par l'Observatoire National de l'ANDRA,
- la publication du rapport n° 2 de la Commission Nationale d'Évaluation

I .5.1 L'inventaire national des déchets radioactifs

L'article 13 de la loi du 30 décembre 1991 confie à l'ANDRA la mission de "répertorier l'état et la localisation de tous les déchets radioactifs se trouvant sur le territoire national". En juillet 1997 a été publiée la cinquième édition de l'inventaire en application de cet article.

Plus de 1 100 sites contenant ou susceptibles de contenir des déchets radioactifs sont répertoriés dans cet inventaire. Il s'agit d'installations correspondant aux différents producteurs de déchets du cycle du combustible et de l'industrie nucléaire (CEA, COGEMA, EDF...), mais également de "petits producteurs" parmi lesquels on trouve les utilisateurs de radioéléments artificiels pour les besoins de l'industrie, de la recherche et de la médecine. Notons que 45 fiches correspondent à des établissements travaillant pour la Défense Nationale.

L'inventaire 1997 s'est particulièrement intéressé aux lieux d'extraction et d'utilisation du radium dans la première moitié du siècle. L'enquête historique ainsi menée a permis de redécouvrir des sites contaminés ou potentiellement contaminés dont on avait perdu la mémoire.

I .5.2 Les laboratoires souterrains

La reconnaissance géologique démarrée en 1994 dans le département de la Vienne, celui du Gard, et dans la zone située à la frontière de la Haute-Marne et de la Meuse s'est achevée à la fin du premier semestre 1996. Cette reconnaissance avait pour but de préciser l'aptitude de chaque site issu de la médiation à recevoir un laboratoire de recherche souterrain.

Au cours de ce premier semestre 1996, les travaux suivants ont été effectués:

- dans le département de la Vienne, où la formation envisagée est un massif granitique âgé de 360 millions d'années, sous couverture, les travaux (forages, tests) ont porté sur la qualité géotechnique de la couverture sédimentaire et sur la caractérisation

hydrogéologique de l'interface granite – couverture sédimentaire à proximité de l'emplacement pressenti pour le laboratoire souterrain. Par ailleurs, la caractérisation hydrogéologique des aquifères de surface (puits, source) et en profondeur (pression, température) a été poursuivie grâce aux mesures chroniques qui ont été effectuées.

- dans le département du Gard, où la formation envisagée est une couche crétacée de siltite âgée de 100 millions d'années, les travaux (forages, tests) ont porté sur la caractérisation de cette formation et sur l'hydrogéologie des formations de couverture et sous-jacentes. Par ailleurs, la caractérisation hydrogéologique des aquifères de surface (puits, source) et en profondeur (pression, température) a été poursuivie grâce aux mesures chroniques qui ont été effectuées.
- en ce qui concerne la Haute-Marne et la Meuse, où la formation envisagée est une couche jurassique d'argilite âgée de 155 millions d'années, les travaux (forages, tests) ont porté sur la caractérisation mécanique de la couverture sur la couche d'argilite et sur l'hydrogéologie. Par ailleurs, la caractérisation hydrogéologique des argilites de surface (puits, source) et en profondeur (pression, température) a été poursuivie grâce aux mesures chroniques qui ont été effectuées.

Sure la base des travaux de recherche géologique qui se sont poursuivis jusqu'à la mi-96, ont été réalisées sur chacun des trois sites retenus, les trois principales tâches suivantes :

- élaboration d'un avant-projet sommaire de laboratoire souterrain définissant en particulier:
  - les caractéristiques dimensionnelles des installations de surface, des puits et des galeries souterraines
  - la nature et les caractéristiques dimensionnelles du revêtement/soutènement des puits et des galeries souterraines,
  - le type d'équipement des installations de surface et souterraines.
- élaboration d'un programme d'expérimentation à réaliser en laboratoires souterrains
- dépôt d'un dossier de demande d'autorisation d'implantation d'exploitation comprenant:
  - un mémoire géologique
  - une description des installations de surface et souterraines
  - une étude d'impact
  - une étude de dangers
  - une notice de conformité d'hygiène et de sécurité
  - un projet de cahier des charges.

Ces dossiers ont été déposés auprès de l'administration à la mi-96 et sont actuellement en cours d'instruction.

I .5.3 Commission Nationale d'Évaluation

Une Commission Nationale d'Évaluation (CNE) a été mise en place en mars 1994 avec pour mission de faire part chaque année, au gouvernement français, de l'état d'avancement des 3 voies de recherche prévues par la loi, puis, à l'issue de la durée de 15 ans, de rédiger un rapport global d'évaluation sur ces recherches et, le cas échéant, sur un avant-projet de stockage pour les déchets radioactifs à vie longue que pourrait présenter l'ANDRA.

Dans son deuxième rapport annuel publié en juillet 1996, la CNE a continué son évaluation des recherches en cours sur les trois axes prévus par la loi, à savoir :

- la recherche de solutions permettant le séparation et la transmutation des éléments radioactifs à vie longue présents dans les déchets;
- l'étude des possibilités de stockage réversible ou irréversible dans les formations géologiques profondes, notamment grâce à la réalisation de laboratoires souterrains;
- l'étude des procédés de conditionnement et d'entreposage de longue durée en surface de ces déchets.

Le troisième rapport de la CNE sera publié en septembre 1997.

I .5.4 Activités des centres de stockage de surface.

I .5.4.1 Le centre de La Manche

Premier centre français de stockage en surface de déchets à vie courte, de faible et moyenne activité ouvert en 1969, le centre de La Manche est arrivé en fin d'exploitation le 12 juillet 1994 après avoir reçus près de 1 500 000 colis. La prochaine étape de la vie du centre est le passage en phase de surveillance. Durant cette phase, le Centre et son environnement seront surveillés en permanence.

Ce passage en phase de surveillance fait l'objet d'une procédure administrative d'autorisation qui a débuté en 1995. Une première étape de cette procédure est constituée par un enquête publique confiée à une commission d'enquête. Cette commission a rendu ses conclusions début 1996 et a émis un avis favorable.

I .5.4.2 Le centre de l'Aube

Le centre de l'Aube a pris le relais du centre de La manche depuis 1994. En 1995, 16 573 m³ représentant 21 200 colis ont été stockés. 21 445 fûts métalliques de 200 litres ont été stockés. 21 415 fûts métalliques de 200 Litres ont été compactés dans l'atelier de conditionnement des déchets. Ce volume, en nette diminution par rapport aux premières évaluations est la conséquence de la politique de réduction des quantités de déchets, mise en place par les producteurs. Si les conditions actuelles se maintiennent la période d'exploitation du centre pourrait être supérieure à 45 ans au lieu des 30 ans prévus initialement.

Further information can be obtained from: *Mr. P. Barber, Relations Internationales, Agence Nationale pour la Gestion des Déchets Radioactifs (ANDRA), Parc de la Croix Blanche, 1-7, rue Jean Monnet, F 92298 Chatenay-Malabry Cedex, [Tel: +33 (1) 46 11 80 68, Fax: +33 (1) 46 11 82 68].*

I .6 GERMANY

I .6.1 Spent Fuel Interim Storage

Commissioning of the Pilot Conditioning Plant (PKA) is planned for 1997/98. This plant is for the consolidation of spent fuel elements to be disposed of without reprocessing after a period of interim storage at Gorleben. The status of the central interim storage facilities, away from the reactor is as follows:

- Gorleben transport and storage cask facility: in operation, 5 casks for spent fuel elements (3 CASTOR V/19, 1 CASTOR lla, 1 CASTOR lc) and 3 HAW casks (2 CASTOR HAW 20/28-CG and 1 TS 28V) are stored, further transports are planned;
- Ahaus facility: in operation, 305 CASTOR THTR/AVR casks are stored:
- Jülich facility: in operation 96 CASTOR THTR/AVR casks are stored;
- ZAB Lubmin: in operation, 4435 WWER fuel elements are stored: and
- ZLN Rubenow: under construction

I .6.2 Disposal of Radioactive Wastes

I .6.2.1 Morsleben Repository

The Endlager für Radioaktive Abfälle Morsleben (ERAM, Morsleben Repository for radioactive wastes), an abandoned salt mine located near the village of Morsleben (Saxony-Anhalt), was designed for the disposal of short lived low – and intermediate – level radioactive waste in the former German Democratic Republic(GDR). The operation has the status of a federal repository. The present operation license expires 30 June, 2000.

In 1996 and in the first half 1997, waste volumes of approximately 5500 m^3 and 2500 m^3 were emplaced in the repository, respectively. Until 30 June 2000 approximately 40,000 m^3 low – and intermediate – level radioactive wastes with a total activity of approximately 20 PBq shall be disposed of.

The Federal Office for Radiation Protection (BfS) prepares documents for the plan approval procedure concerning the decommissioning of the Morsleben repository.

I .6.2.2 Planned Konrad Repository

The competent authority for the plan approval procedure – Lower Saxony's Ministry of the Environment (NMU) – continues with the licensing process. In this connection, the draft plan-approval-decision submitted to the NMU in October 1994, is not used.

In March 1997, the BfS finished its work to improve the documents concerning approval of the planned Konrad repository.

The BfS expects the license in the second half of 1997. The BMU, supervisory authority for the licensing procedure intends to finish the plan approval procedure until the end of 1997. The construction of the facility could be started in the beginning of 1998.

I .6.2.3 Gorleben Exploratory Mine

The reconnaissance work at Gorleben has been continued in 1996/1997. In October 1996, both shafts were connected by a drift at a depth of 840 m. At that depth rooms for installing the equipment for the underground site investigation and the infrastructure of the exploratory mine have been excavated. The present length of these drifts amounts to approximately 1600m. Further, drillings for geoscientific investigations are carried out. The current total length of drills is approximately 5000 m. The salt resulting from excavation works is transported to a salt heap near the mine.

Further information can be obtained from: *Prof. Dr. H. Lummerzheim, Head, Waste Management Division, Bundesministerium für Forschung und Technologie, Godesberger Allee 185-189, Postfach 200240, D-53170 Bonn, [Tel: +49 (228) 59 3762, Fax: +49 (228) 59 3605],*

and Dr. M. Bloser, Ministerialrat, Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU), RS III 6, Postfach 12 06 29, D-53117 Bonn, [Tel: +49 (228) 305 2951, Fax: +49 (228) 305 2899].

I .7 HUNGARY

I .7.1 Existing Regulation: Act Nr. 1 of 1980 on Atomic Energy and its Executive Orders

The application of atomic energy is now regulated in Hungary by the Act Nr. 1 of 1980. It reflects the system of a centrally planned economy, where all the facilities were state owned. With respect to the radioactive waste management it requires that the safe storage of radioactivity be assured as a prerequisite for a licence of any application of atomic energy. However, as it does not provide for special funding for RW management and for the decommissioning of nuclear facilities these problems are still waiting for a solution. This Act will be replaced on the 1 of June 1997 (the date of its entry into force) by the new Act Nr. CXVI of 1996 on atomic energy, regulating among others also the outstanding areas of radioactive waste management.

The executive order of the Act Nr. 1 of 1980 – issued also in 1980 – defines the responsibility of various Ministers in the field of the application of nuclear energy and the Minister of Public Welfare was authorised to regulate the disposal of radioactive wastes. *The order of the Minister of Public Welfare* was issued in 1988. It regulates the requirements of radiation safety, the licensing procedure of the application of atomic energy other than nuclear facilities (research reactors and nuclear power plants) and the special requirements for the final disposal of radioactive wastes.

The ministerial order specified also those other authorities who are involved in the licensing process. In Hungary it is the general rule of administration that a licensing authority invites in its licensing procedure all those other regulatory organisations who are authorised to make decisions related to the subject of the procedure from some special point of view. The licence can be granted only if all the involved authorities gave their consent to it. In the case of a radioactive waste repository the following authorities have responsibilities:

Licensing authority: State Public Health and Medical Officer Service (on behalf of the Minister of Public Welfare)

Other authorities participating in the licensing procedure of the licensing authority: Inspectorates of Environment Protection, Veterinary and Food Control Service, Hungarian Geological Survey, General Inspectorate of Transport, National Headquarters of Fire Protection, National Headquarters Civil Defence, National Police Headquarters.

Some other authorities have also regulatory tasks in connection with the radioactive waste management, such as the Hungarian Atomic Energy Authority in waste collection, handling and treatment on the site of nuclear facilities and in international transportation, packaging and recording of radioactive materials.

A facility for final disposal of radioactive wastes – like any other facility – is subject also to the conventional licensing procedure. The relevant authorities and organs are among others the following Municipal administration (utilisation of land and construction of buildings), Hungarian Mining Authority, National Agency for Nature Conversation, National Water Management Directorate, National Agency for Historic Monuments, etc.

In 1988, when the first attempt was made to select a site for LLW/ILW disposal – in accordance with the internationally accepted view – it was supposed that the repository for LLW/ILW will be a shallow ground repository, just as the existing one in Püspökszilváy that has been used since 1976 for the disposal of institutional radioactive waste. Therefore the ministerial order of the Minister of Public Welfare specified requirements related to this type of facility, like the following:

- A shallow land disposal facility can be sited only in a geological environment acceptable from the point of view of tectonics, seismology, etc. and at least on 1 km distance from larger living areas, recreational districts, surface waters (river, lake) dams, mines and factories producing dangerous and explosive goods.
- If the natural parameters of the site are not quite adequate, the selected site should be improved by engineered structures.
- The disposal can be accepted as a final one only if its lasts at least twenty times the half-life of the longest lived dominant radionuclide.
- In the post-closure period the operator has to provide for the supervision of the facility, for the monitoring of radiation in the environment and the prevention of the intrusion of persons and animals for at least fifty years and after that date as long as the authority requires it.

These selected examples show that some basic requirements are defined, however, further work is to be done with respect to the classification of radioactive wastes, the definition of exemption levels, waste acceptance and site selection criteria.

In 1993 a *National RW Management Project* was launched to solve treatment and disposal of LLW/ILW of the nuclear power plant. In the framework of the project a complex strategy has been elaborated for the management of all types of radwastes from the NPP, including HLW, spent fuel and wastes from the decommissioning of the nuclear power plant. By the end of the first phase of the project that was realised between 1993-1996 the possible sites – accepted by the public – were selected for the LLW/ILW wastes.

The National RW Management Project included also a program to elaborate the technical basis for the detailed legal regulations. An analysis was prepared to compare the Hungarian regulations with the internationally accepted requirements to define those areas where further regulations should be issued or where the existing ones should be amended. In the first step a proposal was elaborated for the definition of exemption levels and waste acceptance criteria.

I .7.2 The New Legal Basis: Act Nr. CXVI of 1996 on Atomic Energy

In December 1996 the Parliament passed the new law on atomic energy that reflects the changes in our social, political and economical system, the experience gained since 1980 with the application of atomic energy as well as the internationally accepted basic principles and requirements in the field of nuclear and radiation safety. One of its most important chapters is dealing with RW management, the responsibilities for it and another one with its funding.

Under the *new Nr. CXVI of 1996* (that enters into force on the 1 of June) the Parliament's prior approval is required to initiate the establishment of a radioactive waste disposal facility. It regulates also the regulatory aspects of the radioactive waste management.

The scope of authority of the Minister of public Welfare: The Minister of Public Welfare, through the State Public Health and Medical Officer Service performs the licensing and controlling the siting, construction, commissioning, operation, modification and closure of a radioactive waste

disposal facility. In the licensing procedure all other public administration organisations participate as so called special authorities, in their scopes of authority and responsibility identified by separate legal regulations:

Through organisations appointed in a separate legal regulation

a) the Minister of the Interior enforces the considerations relating to public and internal order, fire protection, security, as well as civil defence;
b) the Minister of Agriculture enforces the considerations related to food quality, plant and animal hygiene, as well as soil protection;
c) the Minister of Industry, Trade and Tourism enforces the considerations related to geology;
d) the Minister of Environment Protection and Regional Development enforces the considerations related to environment protection, nature conservation and water quality protection;
e) the Minister of Transport, Communication and Water Management enforces the considerations related to traffic, transport, as well as water utilisation and protection of water bases;
f) the building authority competent for the area enforces the considerations related to regional planning and building;
g) the President of the Hungarian Mining Authority enforces mining technological, mining technical and mining safety considerations.

Regulation of the storage and disposal of radioactive waste and spent nuclear fuel: the Act requires that a licence for the application of atomic energy shall be granted only if the safe storage, i.e., interim storage or final disposal, of the radioactive waste and spent fuel generated can be assured in accordance with the most recent proven results of science, internationally accepted norms, as well as experience. Under the Act the interim storage and final disposal of radioactive waste and spent fuel shall be considered safe if:

a) the protection of human health and the environment is ensured during the whole period of these activities;
b) the effect exercised on human health and the environment is not higher beyond the country borders than that accepted within the country.

The performance of tasks related to the final disposal of radioactive waste, as well as to the interim storage and final disposal of spent fuel, and to the decommissioning of a nuclear facility will be the responsibility of *an organisation designated by the Government*, for their solution is in the national interest. The governmental decree establishing this organisation is now drafted and will enter into force on the 1 of June 1997.

The Act is also requiring that the licensee, or in the case of budgetary organisation, the central budget shall be liable to cover the costs of the final disposal of radioactive waste, as well as the interim storage and final disposal of spent fuel, and of the decommissioning of a nuclear facility. For this purpose the *Central Nuclear Financial Fund* will be set up as of the 1 of January 1998. The Fund is a separate state fund pursuant to Act XXXVIII of 1992 on Public Finance exclusively earmarked for financing the construction and operation of facilities for the final disposal of radioactive waste, as well as for the interim storage and final disposal of spent fuel, and the decommissioning of nuclear facilities.

The Hungarian Atomic Energy Authority – under the control of the Government – continues to play an important role in the field of the radioactive waste management. The member of the

Government exercising supervision over Hungarian Atomic Energy Authority (HAEA) shall dispose of the Fund and the manager of it will be the HAEA.

The licensees are obliged to cover the costs of the final disposal of radioactive waste, as well as of the interim storage and final disposal of spent fuel, and of the decommissioning (demolishing) of nuclear facilities by contributing to the Fund. In the case of nuclear facilities, the amount of payment shall be determined in a way that it fully covers all the costs arising as a result of the final disposal of radioactive waste and of the interim storage and final disposal of spent fuel generated during the total operating and institutional control period of the facility and at the time of decommissioning, as well as all the costs related to the decommissioning of the nuclear facility.

The amount of payments will be determined by the law on the annual budget on the basis of the cost estimate prepared by the organisation responsible for the radioactive waste management. The payments made by the licensees may be accounted for within the category of other costs. In the case of a nuclear power plant, these should be taken into account when determining the price of electric energy.

The detailed regulation of radioactive waste management as well as other executive orders of the new Act on Atomic Energy are now drafted and will provide a new, up-to-date legal framework for the peaceful application of atomic energy in Hungary.

Further information can be obtained from: *Ms. Ildikó Czoch, Deputy Director General, Hungarian Atomic Energy Authority (HAEA), PO Box 676, H-1539 Budapest 114, [Tel: +(361) 155 9764, Fax: +(361) 175 7402].*

I .8 ITALY

I .8.1 Nuclear Waste Programme

At ENEA the conditioning of the radioactive wastes produced in the past nuclear activity is now actively pursued. The main achievements are shortly listed below.

1. For the conditioning of some 200 m^3 of HLW and LLW stored at EUREX plant (Saluggia, northern Italy), a vitrification process based on the French technology has been finally selected through an international call for tender. The contract for the realisation of the unit is being signed with a group o companies including the French SGN. The vitrification station is expected to be in operation in five years. The realisation at EUREX plant will be a major undertaking in Italy in the waste management in the coming years.

2. At Trisaia Research Center (southern Italy) the cementation plant SIRTE, the first solidification plant for liquid LLW operated in Italy, in operation since May 1995, has solidified some 80% of the liquid LLW.

   The facility is presently being modified to allow the cementation of the some 3 m^3 of high active liquor produced during the reprocessing campaign of the ITREC pilot plant. The solidification of the liquid wastes at the site is expected to be completed by the year 2000.

   At Trisaia Center a site remediation activity is also under way, allowing the safe disposal of some 1000 m^3 of contaminated soil collected during the recovery of buried drums

containing solid LLW. The completion of the remediation activity should be achieved by the end of the year.

3. Under the government direction, ENEA has undertaken actions directed to select and qualify a site for the final repository for LLW. A special Task Force, purposely appointed to implement the required actions, is now pursuing the activity for a preliminary site screening and selection. The repository is planned to be in operation in ten years.

Further information can be obtained from: *Mr. G. G. Eletti, ANPA, Via Vitaliano Brancati 48, I-00144 Roma, [Tel: +39 (6) 5007 2015, Fax: +39 (6) 5007 2941] and Mr. P. Risoluti, ERG-RAD, ENEA-Casaccia, Via Anguillarese 300, I-00060 Roma, [Tel: +39 (6)3048 3133, Fax: +39 (6) 3048 3147].*

I .9 JAPAN

I .9.1 National Policy on Radioactive Waste Management

I .9.1.1 Establishment of Radioactive Waste Policy Division

In April 1995, High-level radioactive waste (HLW) with the reprocessing of the spent fuel entrusted to abroad was started to return to our country. On the other hand, it has not been yet determined on the measures of the radioactive waste which is related to the radioisotope used in factories, hospitals, laboratories, etc.. In addition, the policy has not been determined either on the decommissioning of nuclear facilities such as the nuclear fuel factory without also establishing the concrete measures for the dismantling of the nuclear power plant assumed shortly. Then it becomes the urgent issue that establishment of the technology of the measures on radioactive waste and decommissioning of the nuclear facilities and smooth promotion.

Based on such state, "Radioactive Waste Policy Division" was established in the Atomic Energy Bureau, Science and Technology Agency in May 1996. This division unitarily administer the office works such as planning of the fundamental policy, adjustment of the office work of the relation executive agency, planning of the policy of research and development on radioactive waste and decommissioning of nuclear facilities.

I .9.1.2 Round Table Conference on Nuclear Policy

In March 1996, Atomic Energy Commission (AEC) of Japan established "Round Table Conference on Nuclear Policy" to gain broad public understanding and acceptance on research, development and utilisation of nuclear energy. In the Conference, a number of views and opinions of people in various fields were expressed that the plans for high-level radioactive waste (HLW) disposal should proceed without delay because it is an extremely important issue which needs to be dealt with urgently. It was further recognised that a key aspect of proceeding with such plans is obtaining the understanding and confidence of the public, based on a convincing demonstration of safety. As stated in the document "*Carrying Out Future Atomic Energy Policy*" published in October 1996, the AEC has decided to formulate concrete measures for HLW disposal and to present these to the nation in a clear and well-defined form.

I .9.1.3 Special Committee on High-Level Radioactive Waste Disposal

"Special Committee on High-Level Radioactive Waste Disposal" of the AEC provides a forum for discussing broader aspects of HLW management, including social and economic issues, the ultimate aim being to facilitate smooth execution of the geological disposal program. In this Committee, with the participation of specialists from wide range of fields such as environment, ethics, law, economics and so forth including an ecologist, the formulation of concrete measures of HLW disposal, for example, a structure for the implementing organisation, establishment of operating funds and site selection process is under deliberation.

I .9.1.4 Advisory Committee on Nuclear Fuel Cycle Backend Policy

Since its establishment in 1995, the "Advisory Committee on Nuclear Fuel Cycle Backend Policy(ACNBP)" of the AEC has been discussing ways which conduct future R&D program relating to geological disposal.

According to the "*Long-Term Plan for Nuclear Research, Development and Utilisation*" formulated by the AEC in June 1994, the Power Reactor and Nuclear Fuel Development Corporation (PNC), which is the core organisation responsible for R&D activities relating to HLW disposal, will document its activities, together with those of related R&D agencies, in the form of the Second Program Report by the year of 2000. This will be submitted to the Japanese Government, which will then conduct an evaluation of the technical feasibility and safety of geological disposal of HLW in Japan.

In this context, ACNBP has been deliberating issues such as the way to structure R&D program to be performed by other agencies and organisations with PNC as the nucleus, identification of technically important issues and objective and transparent evaluation of research results for preparation of the Second Program Report. The results of the deliberation was documented as the draft report of "*Guidelines on Research and Development Relating to Geological Disposal of High-Level Radioactive Waste in Japan*". This draft report consists of two parts, Part 1 that discusses the basic technological issues applying to geological disposal of HLW in Japan and matters to be included in the Second Program Report, and Part 2 that highlights technically important issues which have to be covered by way of preparation for the Second Program Report. The draft report was informed to public in order to collect their views and opinions, which are currently under consideration by ACNBP to finalise the draft.

I .9.2 Recent Topics on Radioactive Waste Management Activity

I .9.2.1 Low-Level Radioactive Waste

Low-level radioactive waste disposal center for solidified homogeneous waste generated from nuclear power plant has been in operation at Rokkasyo-mura in Aomori Prefecture since 1992.

License application for second stage of disposal facility has been started in February, 1997. Solidified dry low level radioactive wastes such as metal, thermal insulator and plastic are planned to be disposed of at the facility.

I .9.2.2 High-Level Radioactive Waste

Vitrification Technology

With respect to immobilisation technique of high level radioactive waste, PNC's Tokai Vitrification Facility (TVF) is in operation, after PNC received its full operational license from the government in December 1995.

Underground Research Laboratory

PNC has been promoting an Underground Research Laboratory (URL) at Mizunami city located in the center of Japan, after the prefectural and local government and PNC signed an agreement which sets out a safety basis for conducting the research program in the laboratory in December 1995. In the URL, it is planned to conduct a comprehensive geoscientific research, and provide fundamental knowledge of groundwater and rock mass in deep underground to the research and development for geological disposal. The schedule consists of three phases over the next 20 years with a total estimated budget of 60 billion yen.

(Phase-I) Pre-investigation and Prediction

Surface-based investigations will be carried out in a specified area to provide a rough picture of the geological situation. Simple geological and hydrogeological models will then be generated in order to predict what will be encountered in the second phase of investigations. The surface facilities and related infrastructure will be constructed in this first phase. A duration of at least 5 years is foreseen for this phase.

(Phase -II) Excavation of shafts and drifts

A shaft and several drifts will be constructed in a stepwise procedure; this will run in parallel with a series of observations and measurements of rock and groundwater properties. The predictions made during the first phase will be evaluated and a more detailed picture of the geological environment drawn up. The effects of excavation on the surrounding rock mass will also be studied. According to current scheduling, it is estimated that this second phase will last around 8 years.

(Phase -III) Research in the underground drifts

Once underground construction is complete, a series of investigations and experiments will be conducted in the various shafts and drifts in order to study relevant phenomena occurring in the deep geological environment over long time periods. A duration of at least 12 years is foreseen for this third phase.

The research projects are expected to be executed with the participation of researchers from not only other research organisations concerned in Japan but also ones abroad. Furthermore, the URL is completely separated from the actual processes involved in selecting and characterising a potential site and constricting a repository.

Steering Committee on High-Level Radioactive Waste Project

Established in May 1993, SHP has been promoting investigation which is necessary to prepare measures to encourage the establishment of implementing organisation regarding the disposal of high-level radioactive waste under the public understanding and Cupertino that will be established around the year 2000.

In May 1996, SHP issued the Intermediate Report summarising the results of basic consideration such as operation plan, implementing organisation, operating funds, harmonisation with local communities and promotion of public understanding. SHP will continue to deliberate to prepare for formulation of concrete measures.

I .9.2.3 Decommissioning

As the Japan's basic philosophy on decommissioning, a commercial power reactors is considered to be dismantled and removed as soon as possible after its operation is terminated, taking into account safety, social issues and reutilization of its site. Based on this philosophy, the Japan Power Demonstration Reactor (JPDR) decommissioning program was conducted by JAERI since 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 program was successfully completed by the end of March, 1996. The extremely low level radioactive waste arising from demolishing the JPDR biological shield was disposed into the near surface burial place as a safety demonstration test. The research and development of advanced decommissioning technologies has been conducted under consideration of lessons learned in the JPDR decommissioning program. In addition, the JAERI Reprocessing Test Facility (JRTF) decommissioning program started in December, 1996 to demonstrate the dismantling of fuel cycle facilities. This program will continue until 2004.

I .9.2.4 Return of Vitrified Residues Occurred through Overseas Reprocessing

Japanese electric power companies program 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 residues to be returned from COGEMA and BNFL is estimated approximately three thousand and several hundred canisters at this stage. Vitrified residues are securely placed inside specially designed transport flasks, and the return transport is made by sea using a specially designed vessel. The flask 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 return transport of vitrified residues from France and the UK to Japan is expected to last about 10 years once or twice a year. They are to be stored and managed in the Waste Management Facility of Japan Nuclear Fuel Co., Ltd. in Rokkasho-mura, Aomori Prefecture.

With regard to the first return transport, the shipment of 28 canisters from France was received in April 1995.

Further information can be obtained from: *Dr. S. Muraoka, Deputy Director, Department of Environmental Safety Research, Japan Atomic Energy Research Institute (JAERI), Tokai-Mura, Ibaraki-Ken, 319-11, [Tel: +81 29 282 6323, Fax: +81 29 282 5820, E-mail: muraoka@sparcit.tokai.jaeri.go.jp].*

I .10 KOREA

I .10.1 Programme for LILW Disposal

After the withdrawal of the Guleop Island in December 1995 by the confirmation of active fault zones near and along the island the attempt to investigate new repository site could be delayed until the beginning in the next century. Therefore, it may be expected that the programme to build a repository for LILW by the year 2001, which was decided at the 236th and 237th meetings of the Korea Atomic Energy Commission (AEC), would be delayed over at least a few years.

At the end of the year 1996 the role of overall project management for LILW was transferred from the MOST (Ministry of Science and Technology) and KAERI (Korea Atomic Energy Research Institute) to the Ministry of Trade, Industry and Energy Resources (MOTIE) and KEPCO (Korea Electric Power Co.) by the amendment of "*Atomic energy Law*" and "*Electricity Enterprise Law*". Then NETEC (Nuclear Environment Technology Institute) was established as a special organisation of KEPCO for the implementation of the followings:

- siting for LILW disposal;
- construction and operation of LILW disposal facility; and
- collection and treatment of the wastes from RI applications.

At present the NETEC studies on the radioactive waste management strategy to support the MOTIE for the revision of LILW disposal programme to the end of this year. This project includes to review disposal methods as well as the size of disposal facility to find the most suitable ones to Korean circumstances.

I .10.2 R&D programme for HLW Disposal

The medium- and long-term nuclear R&D plan, which was established in 1992, has been revised and then the revised plan for a period of 10 years was accepted at the 247th AEC meeting held on June 13 in 1997. Under this plan the technology development programme for HLW disposal has been set up as the following five fields to reach at the target for the development of a reference deep geological repository concept suitable for the Korean geological and industrial circumstances up to the year 2006.

- Repository system development and performance assessment
  - Development of a reference disposal concept
  - Development of safety assessment methodologies.
- Geoenvironmental science research
  - R&D of geoenvironmental assessment methods
  - Site screening for an underground research laboratory and natural analogue studies
  - Site characterisation study
- Engineered barrier development
  - Waste form characterisation and canister material corrosion
  - Canister and/or overpack development
  - Development of buffer material and its characterisation

- Underground radionuclide migration study
  - Radionuclide sorption study and D-base development
  - Radionuclide migration experiment through geologic medium
  - Colloidal transport of radionuclides
- Geotechnical engineering research
  - Design, construction and operation of shallow underground test facility
  - THM coupling phenomena study and related field-experiments

Based on the above fields KAERI has been being actively carried out since 1996.

I .10.3 Current Status of ASARR Project in KAERI

Ever since KAERI officially participated in the ASARR project in December 1995, the proposed two different work scopes have been being carried out with various ASARR samples from different location and depth.

- EPR spectroscopy and diffuse reflectance UV-VIS spectroscopy are applied for the characterisation of solid phases, especially the contents of FeOx and MnOx in the solid samples. Sorption experiments and sequential extraction are being conducted and the spectroscopic approaches are repetitively applied for the identification of remaining oxide minerals. As a by-product, defect centers of kaolinite due to alpha irradiation were identified by EPR, and the potential use of these identifications for tracing back of the uranium migration path will further be studied.
- For the characterisation of rock samples the uranium distribution on the thin section of the samples was determined by alpha track and fission track methods. It was identified in the process of mineral identification by EPMA that one of the samples showed the colloidal structure of illmenite.

KAERI plans to host the following fourth JTC in Taejon, KOREA to be held in around February 1998.

Further information can be obtained from: *Dr. Kwan Sik Chun, Director of Radwaste Disposal Technology Development, Korea Atomic Energy Research Institute (KAERI), P.O. Box 105 Yusong, Taejon, 305-600, Tel: 82 (42) 868-2017, Fax: 82 (42) 864 0355.*

I .11 THE NETHERLANDS

I .11.1 Introduction

A national policy on radioactive waste management was laid down in a position document presented by the Netherlands government to parliament in 1984. It envisaged the institution of a single organisation responsible for the removal, processing and the storage of all radioactive wastes. As a result in the same year COVRA, the Central Organisation for Radioactive Waste, was founded. A decision on the final disposal of the radioactive waste was deferred until it could be reasonable ensured that the safety case for an underground repository would be sufficiently robust. In order to meet the most urgent needs it was also decided that an engineered surface storage facility be constructed whit a capacity to accommodate all radioactive wastes being generated in a period of

50-100 years. Since 1992 COVRA has an interim storage facility in operation for the low – and medium level radioactive wastes at its site in Borsele, which is situated in the south-west of the country.

I .11.2 Organisation

COVRA is entrusted with the management of all radioactive waste generated in the Netherlands.

According to its statutes this includes the collection of the waste generated by small licensees, and the transport to its waste management facility for processing and conditioning. The major waste generators (nuclear facilities or equivalent) usually process their own waste before transfer to COVRA.

The predominantly conditioned waste is kept in interim storage for an extended period of time. Records are kept of relevant identifiers of the waste packages in storage. This allows for instance the identification and separation of packages containing radioactive waste with a short half life which, after full decay of the radioactivity, can be treated as conventional waste. COVRA is also charged with the responsibility to commission research or to participate in research programmes intended to advance the development of disposal methods and techniques for radioactive waste.

COVRA is a private company. 90% of its shares are held by the main waste generators which are the nuclear power stations in Dodewaard (GKN, 30%) and Borsele (EPZ, 30%) and the Energy Research Foundation (ECN, 30%) in Petten. The remaining 10% of the shares are held by the State. The Ministry of Housing, Spatial Planning and the Environment acts as the State's representative in COVRA's Board of Directors.

I .11.3 Interim Storage Facility

Interim storage of all radioactive waste from the Nuclear Power Plants (NPP's) research reactors and other applications of radioactive material is envisaged at the waste facility of COVRA for a period ranging from 50-100 years. This includes the decommissioning of the existing NPP's. The site is designed for a capacity of about 200,000 m^3 of low and intermediate level radioactive waste and about 3,000 m^3 of high level waste. Most of the low and intermediate level waste is stored in a conditioned form in a prefabricated dedicated storage building. In January 1996 about 19,000 m^3 of conditioned waste was held in storage.

A revision of the site license of COVRA envisages the erection of a storage facility for high level radioactive waste with separate compartments for the heat producing and non-heat producing waste. The beginning of the construction is planned in the course of 1997, after the High court has ruled on appeals requesting suspension of the license.

The compartment for the storage of heat producing high level waste is of a vault type in which the canisters are placed in a closed system filled with an inert gas to prevent corrosion. The sealed enclosure for the canisters is in its entirety cooled by natural convection of air.

I .11.4 Disposal Facility

Research on methods for the deep underground disposal of radioactive waste has been carried out under the OPLA programme. This programme focused on the examination of the possibility of long-term disposal of radioactive waste in salt formations. Although it is envisaged that an underground disposal facility would accommodate both high and low/intermediate level radioactive

waste, the safety studies focused on the integrity of the galleries filled with high level waste. After completion of the phases 1 and 1a of the OPLA programme in 1993 it was concluded that from a safety point of view there are no prohibitive factors which would prevent the deep underground disposal of radioactive waste in salt.

Also in 1993 the government adopted a position on the long-term underground disposal of radioactive and other highly toxic wastes, which was presented to parliament, and which now forms the basis for the further development of national radioactive waste management policy: an underground disposal facility shall be constructed in such a way that retrieval of the waste is always possible. This position derives from the expectation that more advanced waste processing methods become available that could specifically isolate and neutralise the long-lived components.

On the strength of this position it was decided that follow-up research be adjusted and concentrated on the elaboration of disposal concepts which meet the requirement of retrievability. It was also decided that the research be extended to host rocks other than salt.

I .11.5 Research

The core of the research in the forthcoming four years will be represented by setting up an inventory and comparing different options for retrievable geologic disposal. One of the key objectives in the follow-up study is to make the main reasons for retrieval transparent in order to be able to determine with reasonable accuracy the period for which this retrieval requirement should apply. The following reasons will be considered:

- To examine the possibility of recycling the waste into the production process or reuse of it for other purposes with the aim to close the life cycles of ray materials to the maximum extent possible.
- To keep the waste available for improved processing techniques should these become available in the future. It is conceivable that for instance a further development of actinide partitioning and transmutation techniques could reduce the amount of long-lived radionuclides and thus achieve a reduction of the long-term radiotoxicity of the waste.
- In the case of direct disposal of spent fuel to keep the door open for the extraction of valuable material when in a later stage reprocessing would be chosen as the most suitable management option.
- To verify the continued validity of the safety assessment for the particular design of the waste disposal facility by appropriate monitoring programmes under realistic conditions.

In the current research programme which is undertaken as a concerted action with research institutes in Belgium and France within the EC Fourth Framework Programme on Waste Management special attention will be give to some derived issues in connection with retrievability such as:

- Functional requirements for deep disposal and applicable constraints.
- Selection of feasible technical concepts of retrievability.
- An estimation of the costs of the selected concepts.
- The impact of the retrievability concept on the safety performance of the envisaged design for the underground disposal facility.

The policy on waste management in the Netherlands aims at close international co-operation between researchers, policy makers and other stakeholders involved in radioactive waste management. In particular the search for a disposal solution which on one hand is validated by internationally agreed performance standards and on the other hand takes account of the specific national approaches and policies regarding sustainable development and closure of production cycles is firmly being

pursued. The first phase of the research programme on retrievability is scheduled to be completed by 1999.

Further information can be obtained from : *Mr. H. A. Selling, Co-ordinator Radioactive Waste Management, Ministry of Housing, Spatial Planning and the Environment, Rijnstraat 3, Postbus 30945, 2500 GX Den Haag [Tel: 31 70 339 4958, Fax: 31 70 339 1314] and Mr. H. T. Cahen, Ministry of Economic Affairs, Directorate General for Energy, Bezuidenhoutseweg 6, postbus 20101, 2500 EC Den Haag [Tel: 31 70 379 7849, Fax: 31 70 379 7841].*

I .12 NORWAY

I .12.1 Repository/Storage Facility for LLW and ILW

On March 14th 1996, the governmental organisation Statsbygg applied for a licence in accordance with the Atomic Energy Act to construct and own a combined repository and storage facility for LLW and ILW at Himdalen, 40 km east of Oslo.

The projected total amount of radioactive waste to be stored and disposed of in the facility up to the year 2030 is equivalent to 10 000 drums. The total activity of the waste has been estimated at about 400 TBq in the year 2030, with most of it being short lived. The total volume of the waste is less than 2 000 m^3.

The facility will be constructed in a rock cavity with a horizontal entrance and the waste will be placed about 50 m below the surface.

The application from Statsbygg with technical documentation has been evaluated by the Norwegian Radiation Protection Authority (NRPA) together with experts in hydrology, geology, seismology, etc., and on January 20th 1997, NRPA recommended the Government to grant the licence.

The licence to build and own the facility was granted by Royal Decree on February 28th 1997.

Statsbygg will very soon start the building of the facility which is planned to be finished in the first half of 1998.

The Institute for energy technology, IFE, is obliged to submit an application for licence to operate the facility. The process of evaluating this application is expected to be finished in due time before the end of the construction period.

Further information can be obtained from: *Mr. G.C. Christensen, Head, Health and Safety Department, Institutt for Energiteknikk, Postboks 40, N-2007 Kjeller, [Tel: +47 (63) 80 60 00, Fax: +47 (63) 81 25 61].*

I .13 SPAIN

I .13.1 General

ENRESA has submitted a proposal for a new General Radioactive Waste Plan to the Ministry of Industry and Energy (MIE). This Plan is expected to be approved by the Government in the first half of 1997.

The main strategic changes included in the Plan are due to a new orientation of the high level waste programme, mainly in relation to the siting decision making process. The next approach aims at taking into account, not only the scientific and technical aspects, but also involvement of society in the process as well as the development of those legal instruments which could regulate it.

In this respect, an Inquiry Committee has been set up within the Senate Commission for Industry in order to study the different aspects related to the problematics of radioactive waste management in Spain, and to analyse the possibilities for developing the legal framework which could facilitate the decision making process for the identification of suitable sites.

Also, the Nuclear Safety Council was restructured last year in order to increase their activities in the High Level Waste Programme.

I .13.2 Very Low Level Waste

A case by case process is being established in order to clear material containing very low concentrations of radionuclides.

Typical examples of cases under study are as follows:

- concrete arising from the dismantling of Vandellós 1 NPP.
- concrete arising from the operations of steam generator replacements.
- metal scrap arising in the operation of NPPs.
- active coal filters used in NPPs.
- lubricant oils used in NPPs.

The practice is based on the common radiological criteria recommended by the IAEA. The compliance with the radiological criteria must be demonstrated by means of an impact assessment methodology recommended by the regulatory body. No generic derived levels are established.

I .13.3 Low and Intermediate Level Wastes

The operation of the El Cabril disposal facility is progressing satisfactorily. As of December 1996 some 7000 m^3 of conditioned waste had been disposed of.

Renewal of the operating licence was granted for a five year period by the regulatory authorities in October 1996. The most relevant change in the new conditions and safety requirements is that the waste acceptance methodology can take credit of the concrete container, which provides a more realistic approach for the application of the waste acceptance requirements.

Efforts are now mainly directed to optimise the whole system with the objective of obtaining the best value of the available disposal capacity.

I .13.4 Decommissioning and Dismantling

ENRESA will start the dismantling operations of Vandellós 1 NPP once the licence is granted by the regulatory authorities. This is foreseen for the first half of 1997.

The Plan foresees to reach a decommissioning level 2 in 4 -5 years, and a decommissioning level 3 after a dormancy period of 30 years.

The in-situ dismantling and site restoration operations of the La Haba uranium mill have been completed.

I .13.5 High Level Wastes

The main changes in the strategic orientation of the new Plan proposed by ENRESA to the Government are fundamentally due to the current difficulties to progress in the siting process. The new proposed approach is based on developing the legal instruments which could enable both the continuation of the R + D field work and the involvement of society in the siting decision making process. This process nevertheless, being time consuming and being subjected to uncertainties in the results, has necessarily to take into account the interim solution as already foreseen in previous Plans.

The current approach foresees three phases aiming at reflecting the needs in different periods in order to ensure the interim storage of spent fuel, thus gaining flexibility in the time schedule for the deep geological repository.

I .13.5.1 Phase 1. Interim Storage of the Spent Fuel at the NPPs

The spent fuel storage capacity of the pools at the nuclear power plants is being increased by means of reracking. This operation has already been completed in six units and is currently in progress in the remaining three units.

This solution will be complemented by means of metallic casks depending on the specific needs of the nuclear power plants. Trillo NPP will need this complementary solution by 2002.

A dual purpose metal cask has already been licensed by the Spanish authorities. This solution will provide sufficient storage capacity at the nuclear power plants during their operating lifetime.

I .13.5.2 Phase 2. Centralised interim storage of spent fuel

The need for an installation of this kind is linked to the decommissioning schedule of the nuclear power plants, and will provide a strategic interim solution aiming at having flexibility in the time schedule for the deep geological repository.

Taking into account the solutions addressed in Phase 1, a centralised interim storage facility would be needed for around 2010, which in principle provides sufficient time for developing the legal framework for the siting process.

Former studies undertaken by ENRESA in the past concluded in the preliminary design of an installation of this kind based on a combination of pool and cask technologies. During 1996 a reevaluation of that study has taken place, which envisages a facility based on dry technologies. This work is expected to be concluded in 1997.

I .13.5.3 Phase 3. Disposal of HLW

Up to now ENRESA has been working according to the guidelines of previous plans in three areas:

- Identification of suitable sites through a step-wise screening process.
- Conceptual designs of a deep geological repository.
- R + D related activities.

The main focal point of the approach proposed in the new plan is the involvement of society in the siting process by providing a legal framework, before undertaking any field work.

Therefore the near-term objectives during the period 1997-2000 will mainly be oriented to the development of the siting legal framework. During this period ENRESA will continue the

development of the preliminary non-site specific conceptual designs, the compilation of the geological data obtained up to now, and the R + D related activities, aiming at concluding by the end of the century a preliminary performance assessment exercise.

On the basis of the available geological information a large number of potentially suitable areas, as well as the specifications for the specific field investigations will be prepared.

The period 2000-2005 will be mainly devoted to carry out the specific field investigations, as well as the identification of volunteer areas which would be subjected to a preliminary characterisation programme.

The construction of underground laboratories could start around the year 2010.

Further information can be obtained from: *Mr. A. Rodriguez Beceiro, Head of the International Relations Department, ENRESA, Calle Emilio Vargas No.7, 20043 Madrid, [Tel: +37 (1) 519 53 14, Fax: +34 (1) 519 57 96]*

I .14 SWEDEN

I .14.1 General

Three political parties in the Swedish Parliament have reached an agreement on shutdown of two Swedish nuclear reactors. The agreement, which will be followed up by a parliament decision this spring, implies a permanent shutdown and an eventual decommissioning of the two reactors at Barsebäck, one before 1 July 1998 and the second before 1 July 2001. A proposal to the Parliament for new legislation on this matter is in preparation. The year 2010, as the year beyond which no reactor should be allowed to operate (according to decision by the Parliament in 1980) does, however, seem to be abolished. The closing of reactor number two is conditional in the sense that there must not be a shortage of electricity. Therefore a program on an ecologically persistent energy system will start.

One alternative energy system is built on the use of biomass for heat production. However, that appears not to be uncontroversial. For a planned biomass plant in an area of Sweden that was contaminated by Chernobyl accident fallout, the release of Cs-137 might cause some environmental problems. This will be examined further.

I .14.2 CLAB

The CLAB interim storage is planned to be expanded from 5000 tonnes to 8000 tonnes. The expansion should be finished by 2004. Work on finalising application for permits for a second rock cavern is ongoing. The EIA-document is being reviewed by the municipality of Oskarshamn. By the end of 1996 about 2500 tonnes of spent fuel were stored at CLAB.

I .14.3 SFR

The final repository – SFR – is operating smoothly. By the end of 1996 about 21 000 m3 of low and medium level waste had been disposed in SFR. Recent estimates show that the present capacity of SFR – 60 000 m3 – will be sufficient for the waste arising from the Swedish programme if all units are operating up to 2010.

I .14.4 Waste Transportation

The sea transportation system has operated without disturbances. In total 79 transport casks with spent fuel and 5 with core components have been transported on the special ship M/S Sigyn to CLAB during 1996. In addition, 68 ATB containers and 70 containers with low level waste have been transported to SFR. M/S Sigyn was also used for other transports and as a floating exhibition for the Swedish nuclear waste handling system during the summer.

I .14.5 Review of SKB's RD&D Programme 95

SKI is responsible for the review of SKB's RD&D programme. The review of SKB's RD&D Programme 95 was finished in the spring 1996. KASAM, the National Council for Nuclear Waste, has submitted its own commentary on the RD&D Programme 95 to the Government. The Governments decision in December 1996 was very much in agreement with SKI's recommendations and can be summarised as follows:

- The programme fulfils the stipulations of the law.
- SKB shall carry out a system analysis of the entire final disposal system (encapsulation plant, transportation system and repository). This analysis shall allow for an overall integrated safety assessment of the entire disposal system. Alternatives to the KBS-3 method should be described as well as variations of the method. The zero alternative (continued storage in CLAB) should also be analysed and ongoing work on transmutation should be presented.
- SKB shall carry out a safety assessment of the long-term safety of the repository and describe needs for supporting research, how research results should be transferred and how uncertainties should be treated.
- SKBs shall supplement the "*General Siting Study 95*" by specifying the factors determining the selection of suitable site.
- The importance of a well-defined and transparent site selection process is emphasised. SKB should be able to specify criteria for evaluation of candidate sites and specify factors disqualifying a site from further investigations.

An unofficial translation of the government decision is attached.

I .14.6 Appointment of a National Co-ordinator for the Siting Process of a Repository for Spent Fuel

Sweden as well as other countries have experienced difficulties in siting a repository for spent fuel. In Sweden the direct responsibility for the siting process is with SKB. To facilitate the process, mainly in co-ordinating the activities of the different local communities and County Boards, a national facilitator/co-ordinator has been appointed by the government. This will not affect the responsibilities of neither SKB nor the authorities.

I .14.7 Siting of a Deep Repository

SKBs ambition is to carry out the siting and construction of required facilities in consensus with the municipalities and the local population. The work in the municipalities, carried out as environmental impact assessment (EIA) provides an open and broad process for this purpose.

The feasibility study in Malå in the northern part of Sweden has been reported. An independent review of the study, initiated by the municipality, is ongoing. The review is planned to be finished in April 1997. SKB is doing some supplementary work of the feasibility study. A local referendum will be held in September 1997.

The feasibility studies in Nyköping (100 km south of Stockholm) and in Östhammar (150 km north of Stockholm – site of Forsmark NPP and SFR) are also ongoing. A preliminary final report about Nyköping is planned to be presented in May 1997.

In October 1996 the municipality council in Oskarshamn (site of Oskarshamns NPP, CLAB and Äspö HRL) decided to participate in a feasibility study. A final programme for this study is in preparation.

The municipality council of Gällivare (in northern Sweden) has recently (February 1997) decided to collect more information about the siting of a deep repository. A decision on whether to let SKB make a feasibility study will be taken during fall 1997.

I .14.8 Encapsulation Plant

Before final disposal of the spent fuel it should be encapsulated. SKB plans to build an encapsulation plant adjacent to the CLAB facility. This plan was announced in the RD&D-programme 92 and design work for the facility started early 1993. It is now foreseen that an application for a siting and construction permit will be submitted in 1999. Encapsulation is planned to be made in a copper canister with a steel insert. The copper will provide corrosion protection and the steel mechanical protection for the fuel assemblies. Each canister will contain up to 12 BWR assemblies or 4 PWR assemblies and will weigh 20-25 tonnes depending on the final design chosen for the steel insert. Two full size canisters have been fabricated and sealed in Cupertino with the Welding Institute in UK

The building of a canister laboratory for further development and testing of final seal welding and non-destructive examination is in progress. The plant is situated in the harbour of Oskarshamn and the start of welding tests is planned to be ready in early 1998.

I .14.9 The Äspö Hard Rock Laboratory

The construction phase of the Äspö HRL is completed and the reporting of 10 years of research and development, "*Verification of pre-investigation methods*" is being finalised in a number of reports. A summary is available in the booklet "*Äspö Hard Rock Laboratory 10 years of research.*"

The operating phase of the Äspö HRL Programme is divided into a number of major experiments within the areas :

- Finalise detailed investigation methodology
- Test of models describing the barrier function of the rock
- Demonstration of technology and function

The ZEDEX project will be finished during 1997. The project aims at understanding mechanical and hydraulic properties of the excavation disturbed zone.

The overall objective of TRUE (Tracer Retention Understanding Experiment) is to increase the understanding of the processes governing retention of radionuclides transported in crystalline rock. A special agreement has been set up within the TRUE programme; TRUE Block Scale. A number of the international organisations participating at Äspö has joined TRUE Block Scale.

A Rock Visualisation System, RVS, will be completed during the beginning of 1997. The system can be used for visualising the rock model created by data from boreholes, tunnels and at ground.

A borehole laboratory – the CHEMLAB probe – was delivered and tested during 1996 and will be put into operation during 1997. The probe will be used for experiments carried out in the rock, during undisturbed conditions, to study radionuclide retardation in the rock.

A Long Term Test of Buffer Material has started and measurements are being made in two boreholes equipped with heaters. The project aims at studying in-situ some of the long-term processes (microbiology, radionuclide transport, copper corrosion, gas transport) for the KBS-3 concept.

Planning of the projects Prototype Repository and Demonstration of Repository Technology has started. The Prototype Repository will focus on testing and demonstrating repository system function and the Demonstration of Repository Technology aims at developing and testing of methodology and equipment for encapsulation and deposition of spent nuclear fuel in a deep repository.

The Äspö HRL agreements with POSIVA, ANDRA and AECL have been renewed. ENRESA (Spain) joined the international participation during 1997 for four years. USDOE terminated their participation as from April 1996 due to budgetary reasons.

I .14.10 Other Projects at SKB

SR 97- Safety Report 1997

SKB is conducting a new safety analysis of a deep repository called SR 97 in order to meet the demand from the government. The new report is due by the end of 1997. A new model for spent fuel corrosion-dissolution is being developed for the new safety report.

EU

SKB participates within the EU Nuclear Fission Safety programme in the following projects:

- Oklo-Natural Analogue-Phase II: Behaviour of nuclear reaction products in a natural environment.
- Palmottu – Transport of radionuclides in a natural flow system at Palmottu
- Palaeohydrology and geoforecasting for performance assessment in geosphere repositories for radioactive waste disposal (PAGEPA) .
- Evidence from Quaternary Infills for Palaeohydrogeology , EQUIP.
- Development of coupled models and their validation against experiments in nuclear waste isolation , DECOVALEX II.

Transmutation

SKBs support to the Swedish research programmes on partitioning and transmutation at the technical universities in Gothenburg and Stockholm will be increased from 1997.

I .14.11 The SITE-94 Project is Finished

SKI has finished the SITE-94 project, an integrated performance assessment study using site specific data (from the Äspö Hard Rock Laboratory) for a hypothetical repository. The final report has been published as an SKI Report. The main objective of the project has been to determine how site specific data should be assimilated into the performance assessment process and to evaluate how uncertainties inherent in site characterisation will influence performance assessment results. This has

been addressed by exploring multiple interpretations, conceptual models, and parameters consistent with the site data. The site evaluation strived for consistency among geological, hydrological, rock mechanical and geochemical descriptions. Other important elements of SITE-94 are the development of a practical and defensible methodology for defining, constructing and analysing scenarios, the development of approaches for treatment of uncertainties, and evaluation of canister integrity.

SITE-94 will be presented at a seminar in Stockholm on April 4, 1997. SKI has asked NEA for a review of SITE-94.

I .14.12 SKI's Post Site-94 Activities

With important licensing work approaching within a few years time, SKI will most probably not start another integrated PA exercise like SITE-94 within the foreseeable future. Instead R&D efforts on performance assessment will be focused on following-up the experiences and possible gaps identified in SITE-94. Among such areas may be mentioned

- development of new and more realistic models for radionuclide transport, in fractured crystalline rock and in the near-field;
- further development and implementation of the scenario and system analysis approach employed in SITE-94 for documentation and quality assurance purposes;
- comparison of the site characterisation in SITE-94 (based on investigations from the surface) and the results from detailed investigations in tunnels at Äspö;
- further development of the canister analysis, e.g. regarding mechanical and chemical impacts in relation to possible ranges of technical specifications and quality control.

I .14.13 International Peer Review of SKI and SSI

On an initiative of the SKI the Swedish Government appointed an international group of experts to review the regulatory activities of SKI and SSI. The commission set up included well-known experts in the field of nuclear safety and radiation protection (e.g. R. Bernero (NRC), A. Carnino (IAEA) and Annie Sugier (IPSN)).

The conclusions by the commission was that the regulatory work of SKI and SSI well serves the purpose of ensuring that the operators of nuclear installations are capable of fulfilling their obligations regarding nuclear safety and radiation protection. The commission also made recommendations aimed at improving processes and procedures to maintain and improve quality and effectiveness in the authorities activities.

I .14.14 SKI and SSI are Developing Regulations

SKI is developing regulations on the safety of management and disposal of spent fuel and radioactive waste. Binding regulations will be supplemented by regulatory guidance documents. The need for regulations has become more obvious as SKB's programme now approaches a licensing phase.

SSI is developing radiation protection regulations on final management and disposal of spent fuel. They will be broadly discussed in Sweden with many authorities, the nuclear industry and others. Comments will also be asked for outside Sweden. The regulations will be applicable on the considerations to be made in the planning of the final disposal of spent fuel. The regulation will cover optimisation, protection of environment, doses to critical groups, timeframes and intrusion.

New regulations on clearance levels for contaminated scrap materials and oil were issued this year. By that the number of routine matters will be reduced considerably both for the authority and for the industry.

I .14.15 Information Activities at SSI and SKI

SSI and SKI are actively taking part in extensive information activities directed to regional politicians and authorities of presumptive regions for siting of a spent fuel repository. An issue of great interest is the process of environmental impact assessment (EIA).

I .14.16 Attachment: The Swedish Governments Decision on SKBs RD&D-Programme 95 (Unofficial translation)

Decision of the Government

On the basis of 12 § of the Act (1983:4) on Nuclear Activities. the Swedish Government has decided the following.

The Swedish Nuclear Fuel and Waste Management Co (SKB) shall, in its further research and investigatory work, carry out a system analysis of the entire final disposal system (encapsulation plant. transportation system and repository). This system analysis shall allow for an overall, integrated safety assessment of the entire final disposal system including how principles for safety and radiation protection are to be applied, in practice, in the safety assessment work. Furthermore. the system analysis shall include an account of the alternative solutions to the KBS-3 method described by SKB in previous research programmes or which have been described in international studies. Different variations on the KBS-3 method should also be described. In addition. the consequences which would arise if the planned repository should not be constructed (zero alternative) as well as ongoing international work on transmutation must be presented.

Furthermore, SKB shall carry out a safety assessment of the long-term safety of the repository. Moreover, SKB shall describe how the need for further supporting research and development work is linked to the safety assessment and how the research results are to be transferred to the final disposal project as well as how basic uncertainties are to be treated in the further work.

No later than in connection with the presentation of the next research and development programme, SKB shall supplement "*General Siting Study 95*" by specifying, in greater depth than before, the factors which should determine the selection of a suitable site for a repository for spent nuclear fuel and long-lived radioactive waste.

The Issue

On September 30, 1995, the Swedish Nuclear Fuel and Waste Management Co (SKB) submitted to the Swedish Nuclear Power Inspectorate (SKI), a programme for research and development concerning the treatment and final disposal of nuclear waste in accordance with the stipulations of 12 § of the Act (1984:3) on Nuclear Activities. The programme is called the "*Treatment and Final Disposal of Nuclear Waste. Programme for Encapsulation, Deep Geological Disposal and Research, Development and Demonstration*" (RD&D Programme 95). Two reports were attached to the programme "*Siting of a Deep Repository for Spent Nuclear Fuel*" (General Siting Study 95) as well as "*Template for Safety Reports with Descriptive Example*" (SR 95). The programme was prepared by SKB on behalf of those who hold a license in accordance with the Act on Nuclear Activities to own and operate a nuclear reactor .

RD&D Programme 95 is the fourth programme which was compiled in accordance with 12 § of the Act on Nuclear Activities. The Government made a decision on the first programme (R&D Programme 86) on November 26, 1987 (cf ME1087/87), the second programme (R&D Programme 89) on December 20, 1990 (cf M90/1165/6), the third programme (RD&D Programme 92) on December 16, 1993 (cf M931252516) as well as on the RD&D Programme 92 Supplement on May 18, 1995 (cf M931122815).

In § 26 of the Ordinance (1984:14) on Nuclear Activities, it is stipulated that SKI should submit, no later than on March 31, 1996, its own review statement on RD&D Programme 95. In a letter dated February 13, 1996, SKI requested an extension of the review period by two months. On March 28, 1996, the Government granted SKI permission to submit its review statement no later than by May 31, 1996.

On May 21, 1996, SKI submitted to the Government a statement on RD&D Programme 95. SKI attached a "*Review Report*" (English translation. SKI Report 96:57) to the statement as well as a "*Summary and Conclusions*" (English translation, SKI Report 96:56). SKI distributed RD&D Programme 95 to various reviewing bodies. The review statements are compiled in SKI Rapport 96:41 (no English translation available).

In accordance with the Government's decision of May 27, 1992, concerning the terms of reference of the Swedish National Council for Nuclear Waste – KASAM (Dir. 1992:72), KASAM presented its review of RD&D Programme 95 in a report entitled "*Nuclear Waste. Disposal Technology and Site Selection – KASAM's Review of the Swedish Nuclear Fuel and Waste Management Co's (SKB's) RD&D Programme 95*" (English translation, SOU 1996:101).

On June 27, 1996, SKB was given the opportunity to submit a statement on SKI's and KASAM's statements. On September 27, 1996, SKB submitted such a statement.

Reasons for the Government's Decision

Like SKI, the Government is of the opinion that RD&D Programme 95 fulfils the stipulations of 12 § of the Act on Nuclear Activities.

The Government has observed that SKB, in RD&D Programme 95, describes the facilities which according to SKB are necessary for a safe treatment and final disposal of spent nuclear fuel and nuclear waste. These facilities comprise a plant for the encapsulation of spent nuclear fuel and a deep repository for the final disposal of the fuel. The intention is to construct the deep repository in stages. The first stage is a demonstration stage with the possibility of retrieving the deposited spent fuel during this stage. According to SKB's plans, the ultimate decision on final disposal of the waste should not be made until after the demonstration deposition has been concluded and the results have been evaluated as well as not until after other alternatives have been considered.

As stated by the Government in its decision of December 16, 1993, on RD&D Programme 92, the Government would like to once again emphasise, in particular, that even if the KBS-3 method should be a reasonable choice of a demonstration deposition method, SKB should not make a commitment to any specific treatment and disposal method before an overall and in-depth assessment of the safety-related and radiation protection issues is presented. It is the opinion of the Government that SKB must compile and describe, in a more detailed manner the alternative solutions to the KBS-3 method which have been presented in previous research programmes. Different variations on the KBS-3 method should also be described. In particular, the consequences which would arise if the planned repository should not be constructed (zero alternative) should be presented in greater depth than it has been so far. The further work on transmutation should also be described.

In its decision of May 18, 1995, on the RD&D Programme 92 Supplement, the Government observed that the decisions made in accordance with Chapter 4 of the Act (1987:12) on the Management of Natural Resources etc. and 5 § of the Act on Nuclear Activities on the construction of the planned encapsulation plant may involve major commitments with regard further treatment and final disposal methods. In the opinion of the Government these decisions should not be made before an assessment of the final disposal system as a whole has been described and the planned final disposal method shown to be suitable. In accordance with the Government's opinion, an overall integrated assessment of the radiation protection and safety-related issues concerning the planned final disposal method as well as concerning other possible alternatives should be made available to the municipalities concerned.

The Government shares SKI's opinion that SKB, in SR 95, has presented a template which is an adequate and flexible framework for future safety reporting. However, the template should be further developed and presented in greater detail in the way described by SKI in its statement to the Government. SKB should also take into consideration the opinions put forward by KASAM in this context. An assessment of the repository's long-term safety should, in the opinion of the Government, be completed before an application is submitted to the authorities for a licence to construct the planned encapsulation plant, as well as before site investigations are initiated at two or more sites.

The Government shares SKI's opinion that SKB's research work is mainly of a high standard viewed from an international perspective. However, in the opinion of the Government, it is important that further research should, to an adequate extent, take into consideration the requirements which may be made on the future evaluations of the safety assessments by the competent authorities. Furthermore it is important that SKB should be able to clearly describe how it intends to treat basic uncertainties. Thus, in the opinion of the Government, SKB should, in its next research and development programme in particular describe how the need for further supporting research and development work is linked to the safety assessments and how the research results are to be transferred to the final disposal project as well as how basic uncertainties are to be treated in the further work.

On May 18, 1995, in the government decision on the RD&D Programme 92 Supplement, the Government stated that SKB should present an overall report of its general studies and site-specific feasibility studies, after their completion, in forthcoming research and development programmes. Results so far achieved as well as a specification of the additional knowledge necessary for further work must also be reported. SKB has presented an overall report of its general studies on a national scale in "*General Siting Study 95*".

In this context the Government would like to emphasise the importance of a well-defined and transparent site selection process. The Government shares the opinion expressed by SKI and KASAM concerning the information presented in "*General Siting Study 95*" and the view which has clearly emerged from the comments of the reviewing bodies on this report, that the ongoing site selection process must be clarified in several respects. In the Government's opinion in the light of the experience gained from the siting work, SKB's overall report on general studies, feasibility studies and any other background and comparative information which, after consultation with the government appointed National Co-ordinator for Nuclear Waste Disposal, SKB may wish to present, must be made available to the municipalities concerned before the site selection process can proceed to the stage of site investigations at no less than two sites. Furthermore, for the planned final disposal method, SKB should be able to specify criteria for the evaluation of candidate sites and specify which factors will determine whether a site will be excluded from further investigations .

Moreover, before site investigations at no less than two sites are initiated, SKB should consult with SKI and SSI on the premises which should apply in the investigation work.

Like the views expressed by SKI in its statement, the Government is of the opinion that SKB should supplement "*General Siting Study 95*" by defining, in greater depth than it has been so far, the factors which should determine the selection of a site which is suitable for a repository for spent nuclear fuel and long-lived radioactive waste. SKB should also describe the consequences of a coastal siting and those of an inland siting of the repository as well as the consequences of siting the repository in southern as well as in northern Sweden. SKB should take into account the other opinions that SKI and KASAM have expressed in their statements concerning "*General Siting Study 95*".

In the Government's decision of May 18, 1995, the Government stated that the applications for licenses in accordance with Chapter 4 of the Act on the Management of Natural Resources etc. and 5 § of the Act on Nuclear Activities to construct a repository for spent nuclear fuel and nuclear waste should contain information for comparative assessments which show that site-specific feasibility studies, in accordance with SKB's description, have been carried out at 5-10 sites in the country and that site-specific studies have been carried out at no less than two sites as well as the reasons for selecting these sites. The Government takes it for granted that SKB, in consultation with the municipalities concerned, will be given the opportunity to carry out site-specific feasibility studies in such a way that an adequate basis for decision is available prior to SKB's consultation with SKI and SSI regarding the site investigations. SKB should make strong efforts to ensure that the municipalities concerned are given as adequate information as possible before different decisions are made in the siting work.

Further information can be obtained from: *Mr. Per-Eric Ahlström, Swedish Nuclear Fuel and Waste Management Company (SKB), Box 5864, S-102 48 Stockholm, [Tel: +46 (8) 665 2834, Fax: +46 (8) 661 5719]; Mr. Sören Norrby, Director, Office of Nuclear Waste, Swedish Nuclear Power Inspectorate (SKI), S-106 58 Stockholm, [Tel: +46 (8) 698 84 82, Fax: +46 (8) 661 90 86]; and Mr. Jan-Olof Snihs, Deputy Director General, Swedish Radiation Protection Institute (SSI), S-171 16 Stockholm, [Tel: +46 (8) 729 7100, Fax: +46 (8) 729 7108].*

I .15 SWITZERLAND

I .15.1 Nuclear power

Swiss nuclear electricity production again reached a record level in 1996. The plant availability factor is over 88.33% (88.0% in 1995). The nuclear component as a fraction of total electricity production was 43% which resulted in a 4% increase in production relative to the previous year. In addition, 3 nuclear plants supply thermal energy for industrial or district heating purposes.

I .15.2 Centralised intermediate storage of radioactive wastes

The Swiss interim store for federal radwastes from medicine, industry and research has been in operation at the site of the Paul Scherrer Institute (PSI) since 1993.

The utility-owned organisation ZWILAG is responsible for storage of HLW, spent fuel and reprocessing wastes, for conditioning of specific L/ILW waste streams and for incineration of wastes. The general license for this facility was agreed to by the Federal Council in mid-1993 and this decision was ratified by parliament in 1994. The nuclear construction license and the operation license for the storage part were granted in August 1996 and the foundation stone of the facility was laid in January 1997. Operation of ZWILAG should commence in a stepwise process from 1999. The

successful realisation of this interim storage facility relieves pressure in Switzerland on establishing permanent disposal routes.

I .15.3 Waste conditioning, characterisation and documentation

The formal procedures for licensing of waste conditioning processes require documentation, process planning and trial conditioning by the waste producer, followed by certification of acceptability for disposal by Nagra and, finally, issue of a permit by the governmental safety authorities (HSK). During 1996, further progress was made by Nagra and the waste producers on the experimental characterisation and quality assurance of different waste streams from power plant operation and especially from the Paul Scherrer Institute. Current interests in improving the waste inventory database concentrate on characterisation of high burn-up and MOX fuel elements and on decommissioning wastes.

I .15.4 Programme for disposal of L/ILW

In June 1993, Nagra announced Wellenberg as the site to be considered for further work towards implementation of a L/ILW repository. A special company responsible for construction and operation was founded in June 1994 (Genossenschaft für nukleare Entsorgung Wellenberg – GNW). In June 1994, the application for the federal General License for a L/ILW repository at the Wellenberg site was submitted together with a report on post-closure safety and a first environment impact statement. A request from the Canton for mining/concession rights was also made in September 1994.

On 25 June 1995, a public referendum was held in the Canton of Nidwalden where the proposed Wellenberg LLW repository should be sited. The purpose of the referendum was to elicit the opinion of the voters on the General License Application of the GNW and to produce a binding decision on the granting of the cantonal concession for excavation of a repository. Both cantonal decisions were negative by a narrow margin (52 to 48%). In Wolfenschiessen, the local Community of the site, on the other hand, a large turn-out of voters (around 90%) voted in favour of the repository project.

Special aspects contributing to the negative vote were, in addition to the active campaign by opponents, the fact that a more phased decision process was preferred and that more details were expected over possibilities for monitoring, control and retrievability of wastes. Subsequent to the political referendum, technical work continued. A synthesis of all geological investigations is being completed, the issues of monitoring and retrievability are being examined in more detail, specific plans for phased work beginning with an exploratory tunnel have been developed and a positive safety authority review of the site characterisation studies to date has been published. Current plans are to submit a modified application for a cantonal concession for an exploratory tunnel alone. This implies that a further concession would have to be granted for repository construction, assuming that the exploratory tunnel confirms the positive site characteristics observed to date.

I .15.5 Programme for disposal of HLW and long-lived wastes

Within the HLW/LLW repository programme, two host rock options are now under consideration: crystalline bedrock (for which a comprehensive regional field investigation programme has been performed to build up a project database) and Opalinus Clay. The goal of the HLW programme is to demonstrate around the end of this century that feasible sites for a repository in Switzerland exist and can with a high degree of probability be identified. This is a high priority goal

although actual implementation of a repository would take place well into the next century and is also dependent upon evaluation of international options.

The choice of the Opalinus Clay was justified in an interim report on the two sedimentary host rocks (clay and molasse) which was issued in January 1994. For the Opalinus Clay option, a license application for an approximately 800 m deep borehole in Benken (25 km north of Zurich) was submitted in 1995 and the necessary federal permit was granted in May 1996 followed by granting of the local permit by the community in February 1997. Legal objections have been raised by two opposing bodies and these are currently under review.

Based on a synthesis (Kristallin-I) of regional field work for the crystalline host rock, further field work was proposed by Nagra. The review of the application for further crystalline drilling by the expert commission of geologists advising the regulatory authorities revealed important differences of opinion. A working group including the regulatory body (HSK), their experts and the implementer (Nagra) met through Spring 1996 and in June a consensus report outlining the next phase was published. It was agreed that further exploration of crystalline bed rock was of value. It was further agreed, that this work be carried out at new site(s) to the West of the existing sites at which Nagra had proposed an intensified drilling programme. This work should consist of seismic studies and deep boreholes. It was agreed that moving to new drilling sites rather than intensifying investigations of existing sites where mixed positive and negative results have been measured may increase the chances of future success. However, delays of a few years relative to the original schedules are also a consequence of the consensus reached. The seismic campaign was already completed at the end of 1996 and is now being evaluated.

I .15.6 Progress of R & D programmes

Within the scope of Phase IV at the Grimsel rock laboratory, a variety of experiments have been performed from 1994 to 1996, partly in collaboration with partners from other countries (Germany, Japan, USA, Sweden, France, Spain). The major experiments in terms of their cost and duration are the radionuclide migration/excavation experiments jointly run by Nagra and PNC, Japan, and the full-scale engineered barrier experiment (FEBEX) run by ENRESA, Spain, and Nagra under the auspices of the EU. A Phase V programme at Grimsel running from 1997 to 2002 is currently under development.

A further in-situ programme with international participation has been initiated at Mt. Terri where a new highway construction tunnel gives access to an underground experimental site in Opalinus Clay. In order to improve the understanding of the hydrogeology of argillaceous rocks, experiments on a modest scale are carried out in a pilot tunnel within the framework of an international project with the following partners: Swiss National Hydrological and Geological Survey (patronage), Nagra, ANDRA, SCK.CEN, PNC, Obayashi Corporation, BGR and IPSN. The present Mt. Terri programme consists of several experiments to obtain information on the hydrogeological, geomechanical and geochemical characteristics of the Opalinus Clay.

Further R & D work is 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 in critical selected areas. At the federal research Institute (PSI), 20% of resources are allocated to nuclear energy research (including contributions from Swiss utilities and from Nagra). The work includes an R & D programme jointly supported by Nagra and the Federal Government, the central theme being the study of long-term repository safety.

Further information can be obtained from: *Mr. H. Issler, Chief Executive Officer, NAGRA, Hardstrasse 73, CH-5430 Wettingen, [Tel: +41 (56) 37 11 11, Fax: +41 (56) 37 12 07].*

I .16 UNITED KINGDOM

I .16.1 Nuclear Industry

The UK announced the conclusions of its review of the prospects for nuclear power in the UK in May 1995. The Government proposed to pass the future responsibility for the seven Advanced Gas-Cooled Reactors (AGR) and the one Pressurised Water Reactor (PWR) to the private sector and the nine older Magnox stations (three of which are closed), would be retained in the public sector. A new company, British Energy plc was formed in December 1995 and owns two subsidiaries, Nuclear Electric Limited and Scottish Nuclear Limited. British Energy was privatised in July 1996.

I .16.2 Nirex

UK Nirex was formed by the nuclear industry to establish a disposal route for radioactive waste. After a wide ranging site selection exercise Nirex announced that they would be concentrating their site investigations on a site near Sellafield, Cumbria, as a potential site for a deep underground repository. As part of this site investigation programme Nirex applied for planning permission to excavate at the Sellafield site a Rock Characterisation Facility (RCF), an underground laboratory which the company say is necessary to assess the suitability of the site. Planning permission was refused by the local planning authority, Cumbria County Council, and Nirex appealed to the Secretary of State for the Environment. A public inquiry was held into the appeal. The outcome of the appeal was announced by the Secretary of State for the Environment on 17 March 1997. The Secretary of State accepted the advice of the Planning Inspector who presided over the RCF Public Inquiry into Nirex's appeal, that the appeal should be refused on a number of grounds.

I .16.3 Radioactive Waste Management Advisory Committee (RWMAC) Financial Management and Policy Review

RWMAC advises the Secretaries of State for the Environment, Scotland and Wales on all aspects of policy concerning the management of civil radioactive waste. The review of RWMAC was announced in July 1996 and is being conducted as part of the Government's programme of regular five-yearly finance management and policy reviews of non-Departmental public bodies. The review comprises two stages: a prior options stage which considers the continuing need for the advice provided by the committee, and whether provision of that advice could be transferred to the private sector, or elsewhere within the public sector; and a second stage considering the structure and method of operation of the committee. The conclusion of the "prior options" stage, completed in November 1996, was that the Committee should continue to operate for at least another five years.

Further information can be obtained from: *Mr. A.G. Duncan, Head of Radioactive Substances Function, The Environment Agency, Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD, [Tel: +44 (1454) 62 4069, Fax: +44 (1454) 62 4032] and Mr. J. Holmes, Director for Science, United Kingdom Nirex Ltd, Curie Avenue Harwell, Didcot, Oxfordshire OX11 ORH [Tel: +44 (1235) 825 253, Fax: +44 (1235) 820 560].*

I .17 USA

I .17.1 U.S. Department of Energy (DOE)

I .17.1.1 Office of Civilian Radioactive Waste Management (OCRWM)

Nuclear energy provides the United States with more than 20 percent of its electricity, with 108 currently operating nuclear power reactors in the U.S. On an annual basis, spent nuclear fuel inventories are growing at a rate of approximately 1800 to 2200 MTU each year; approximately 32,000 MTU of spent nuclear fuel has accumulated to date. It is projected that by 2040, the total spent fuel inventory will total 87,000 MTU. The Nuclear Waste Policy Act of 1982 (Public Law 97-425) established the Office of Civilian Radioactive Waste Management (OCRWM) within the U.S. Department of Energy to develop and safely manage a Federal system for disposing of the Nation's high-level radioactive and spent nuclear fuel

Funding

The Program 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 and sold by nuclear power plants. Contributions are approximately $633 million per year. At the end of 1996, the fund had received a total of approximately $7.9 billion and expenditures of almost $5.3 billion.

Program Strategy

The Conference Report to the 1997 Energy and Water Appropriations includes language that stated FY 1997 appropriated funds be used toward three near-term objectives that will maintain the momentum toward a national decision on the geologic disposal option: 1) Update the regulatory framework in FY 1997 for evaluating the suitability of Yucca Mountain; 2) Complete the Viability Assessment of the Yucca Mountain site in FY 1998; and 3) Recommend the repository site to the President in 2001 if the site is suitable, and submit a license to the NRC in 2002.

Scientific Investigation of Yucca Mountain

Based on the direction in the Energy and Water Development Appropriations Act the Program focused the repository effort on addressing the major unresolved technical questions regarding the conceptual design of the repository and describing its expected performance in the geologic setting. The Program has refocused its efforts at Yucca Mountain to address the critical unanswered technical questions leading to a viability assessment in 1998. In support of the three objectives described in the Program Strategy above, the Program is continuing the construction of the underground exploratory studies facility (ESF), which will facilitate continued scientific studies of the mountain. The tunnel boring machine has completed more than 90 percent of the main five-mile underground loop for the ESF, has passed through the repository level, and has made the turn toward the south portal where it will exit the mountain.

Greater emphasis now will be on construction of alcoves that will penetrate the Ghost Dance Fault, a principle geologic feature of the repository setting, and on heater tests that will provide information on rock mechanics, hydrology, and the chemistry of the formation under the influence of heat in the repository formation.

Nothing has been found to date to indicate that the Yucca Mountain site would be unsuitable for a permanent geologic repository. The data that has been gathered from testing activities within the tunnel continues to confirm that Yucca Mountain's "natural" barrier is an important component of our strategy to isolate the waste that could be disposed in the proposed repository.

Viability Assessment

The revised Program Plan, published in May 1996, defined a viability assessment (VA) which consists of four main tasks: 1) more specific design work on the repository and waste package, and a more specific concept of repository operations; 2) a total system performance assessment describing the probable behaviour of the repository; 3) a plan and cost estimate for the work remaining to complete a license application to the NRC; and 4) a more precise estimate of the costs to construct and operate a repository, based on the latest design and operational concept. In the FY 1997 Energy and Water Development Appropriations Act, Congress directed that DOE provide a VA of the Yucca Mountain site to the President and to Congress by September 30, 1998.

In FY 1996 we focused on design and scientific investigations associated with the first two tasks above, achieving several significant milestones. In March 1996, the Mined Geologic Disposal System Advanced Conceptual Design Report for the repository and waste package was completed. Models for the 3-D geologic framework, site-scale saturated zone and unsaturated zone flow, and saturated zone and unsaturated radionuclide transport were fully developed. A study that will provide a technical basis for a recommendation on whether an additional engineered barrier, such as backfill or other concepts serving similar functions, should be incorporated into the repository system design was also completed.

Two other key milestones were completion of major performance assessments: the Total System Performance Assessment – 1995 and a flow calculation of Yucca Mountain groundwater travel time.

Repository Regulatory Framework

Significant progress was made during FY 1996 in revising DOE's repository siting guidelines (10 CFR Part 960). A Notice of Proposed Rulemaking was published in the Federal Register on December 16, 1996. The revision would streamline the process for determining site suitability, eliminating the original generic requirements that were based on comparisons among competing candidate sites. Under this proposal, the determination of suitability would shift from an evaluation of individual features of the site to an integrated, total system performance assessment of how a repository designed specifically for conditions at Yucca Mountain would perform against regulatory standards – most importantly, the new radiation protection standard that the EPA is developing

Waste Acceptance, Storage and Transportation

During FY 1996, the development of the legal-weight truck cask was terminated, as was the design effort of a multi-purpose canister (MPC). Preparation of the MPC Environmental Impact Statement (EIS) was transferred to the Department of the Navy for preparation of a container system EIS for management of naval spent nuclear fuel. A Request for Expression of Interest and Comments was issued in the Federal Register to solicit views on the proposed market-driven waste acceptance, storage and transportation approach. A Draft Statement of Work for Waste Acceptance and Transportation Services, and a Draft Waste Acceptance, Storage, and Transportation Concept of Operation was also issued. A Notice of Proposed Policy and Procedures on implementing a technical and financial assistance program to states for training related to safe routine transportation and

emergency response procedures was published in the Federal Register. As part of a co-operative agreement with the Electric Power Research Institute, a Dry Transfer System Topical Safety Analysis Report was submitted to the NRC. An agreement with the Idaho National Engineering Laboratory to conduct a demonstration of the system was also negotiated. A Memorandum of Agreement with the Office of Environmental Management to transfer EM ownership and management responsibility for DOE-owned spent nuclear fuel stored at the West Valley Demonstration Project and the Idaho National Engineering Laboratory was also signed.

The revised Program strategy will enable the acquisition of the capability for waste acceptance, storage, and transportation as rapidly and efficiently as possible. The Program's two major near- term objectives to support this effort are to:

- Develop a market-driven waste acceptance, storage, and transportation approach that relies on the private sector for implementation; and
- conduct non-site specific designs and engineering safety analyses for an interim storage facility to reduce facility licensing time, should a site be designated after completion of the viability assessment in September 1998.

Market Driven Approach

The Program is developing a market-driven transportation approach that relies on a procurement process to acquire waste acceptance, storage, and transportation services. A draft request for proposals for these transportation issues was issued in December 1996. Private vendors would arrange to collect spent fuel from utility sites and deliver it to a Federal facility. As the Program moves through the award process, this activity will provide a forum that will help resolve many of the policy and institutional issues confronting orderly initiation of the safe transportation of spent fuel.

Engineering Development Activities

The Program continues to develop a methodology for using burnup credit for transportation of spent nuclear fuel. Following receipt of comments from the NRC on the initial report in March 1996, OCRWM is preparing a revised topical report for burnup credit.

Non-site Specific Design and Engineering Safety Analyses

The Program is developing a topical safety analysis report for the first phase of an interim storage facility based on a non-site specific facility design, under the assumption that an interim storage site will be designated in 1999, consistent with the Administration's policy that the interim storage facility decision should be informed by the results of the Yucca Mountain viability assessment.

Submittal of the report to the NRC in 1997, ahead of site designation, will reduce the time required for preparation of the license application and reduce licensing risks related to design and safety considerations. The report will describe facility design, operations, and supporting systems; demonstrate conformance with the NRC's siting evaluation factors and general design criteria; and present the results of radiological and safety analyses. The report will contain the required analyses and evaluations necessary to demonstrate that operation of the facility would not endanger the health and safety of the public.

Waste Acceptance Litigation

The U.S. Court of Appeals for the District of Columbia Circuit recently ruled that the DOE has an obligation to start disposing of commercial spent nuclear fuel no later than January 31, 1998, under 10 CFR Part 961 – Standard Contract for Disposal of Spent Nuclear Fuel/or High-level Radioactive Waste. DOE formally notified the utility contract holders by letter on December 17, 1996, that it

would be unable to begin acceptance of their spent nuclear fuel in either a repository or an interim storage facility by that date, and invited them to provide their views by March 14, 1997.

I .17.1.2 Office of Environmental Management

Overview

The Environmental Management program at the Department of Energy (DOE) is responsible for addressing immediate, urgent risks to human health and the environment, as well as managing long-term contamination and safety threats. Environmental Management's mission is to manage the nuclear waste and clean up the contamination at Departmental sites across the country. Environmental Management also performs a variety of stabilisation, deactivation and decommissioning, and technology development activities for the Nation. The program is responsible for both the short- and long-term disposal and treatment of nuclear and chemical wastes generated during nearly 50 years of nuclear weapons production and nuclear research at 137 Departmental sites in 33 States and 1 Territory. A 1996 study by the Department estimated that the cost of addressing the environmental legacy of the Cold War will total approximately $227 billion over the next 75 years.

The number of sites and facilities under the program's management has grown as projects have been transferred from other Departmental programs. The program now manages hundreds of high-level radioactive waste tanks and thousands of contaminated buildings that must be deactivated and eventually decommissioned. Environmental Management also is responsible for safely storing 2,700 tons of spent nuclear fuel and stabilising and safeguarding 26 tons of plutonium scraps and residues. Since 1989, the program has treated 4.2 billion gallons of ground and surface water; transported 1,000,000 tons of hazardous materials safely; and remediated over 5,000 public and private properties contaminated with uranium tailings. In 1996, the Environmental Management program began development of a place that will complete cleanup at most sites within a decade. At a small number of sites, treatment will continue for the remaining waste streams, e.g., high-level radioactive waste. The plan should be completed by fall of 1997.

Waste Management

The mission of the Office of Waste Management is to protect people and the environment from the hazards of Departmental wastes by providing an effective and efficient system that minimises, treats, and stores all of these wastes and disposes of most of these wastes as soon as possible. The Waste Management program is responsible for the storage and treatment of high-level waste but not for its disposal; that responsibility falls under the auspices of the Office of Civilian Radioactive Waste Management.

The safe and efficient management of radioactive waste, much of which has been stored at Departmental sites for up to 50 years, is high priority. Currently, waste management facilities store and manage more than 660 million cubic meters of radioactive waste and wide variety of hazardous chemical waste at more than 40 sites nation-wide. Of this 660 million cubic meters of waste, 83 percent is also mixed with hazardous chemicals.

The Waste Management program continues to evaluate and plan for the facilities needed to manage, treat, and dispose of waste generated at DOE sites. These plans must balance the relative costs and the potential risks of activities such as transporting waste from one site to another, storing waste on-site, building treatment and disposal facilities, and ensuring worker safety while handling waste. Integrated planning strategies for each type of radioactive waste managed are being developed

using a 10-year horizon. By 2006, each of the Department's programs for managing each type of waste will achieve at least half of its overall mission, with the exception of high-level waste.

In September 1995, the Department issued a broad, or programmatic, environmental impact analysis of alternative strategies for waste management. This draft Waste Management Programmatic Environmental Impact Statement was developed in accordance with the National Environmental Policy Act (NEPA). The final Waste Management Programmatic Environmental Impact Statement is expected to be issued by the end of calendar year 1997, and will provide the basis for multiple Records of Decision that will define the Department's preferred strategy for managing each type of radioactive waste.

In another effort, the Department continues its work to establish effective compliance agreements that are realistic, challenging, and cost-sensitive, as exemplified in the Department's close work with States, Indian Nations, local governments, the Environmental Protection Agency, and concerned citizens. These plans outline how the Department intends to treat mixed waste. To meet the requirements of the Federal Facility Compliance Act of 1992, Site Treatment Plans for mixed waste, were submitted to the appropriate State or the Environmental Protection Agency in April 1995. By the fall of 1995, the States or the Environmental Protection Agency issued an order requiring the Department's compliance with the 35 approved plans.

During 1996 treatment of high-level radioactive waste began at waste vitrification facilities at the Savannah River Site in South Carolina and the West Valley Demonstration Project in New York. By March 1997, some 170 canisters of high-level waste glass had been produced at these two sites. These canisters will be stored until a geologic repository becomes available.

The Environmental Management program has been taken steps to transfer functions traditionally performed by the Department's management and operating contractors to private companies who will provide the service on a competitive, fixed-price basis. Environmental Management is aiming to privatise the Hanford Tank Waste Remediation System – the largest single project at the Department – to save money and to reduce the technical and cost-performance burden on the Department.

The Waste Isolation Pilot Plant, located near Carlsbad, New Mexico, is an integral part of the Department's long-term planning for transuranic waste disposal. Near-term activities for the Plant include demonstrating compliance with Federal and State environmental regulations and completing other statuary requirements. Under the Waste Isolation Pilot Plant Land Withdrawal Act of 1992, the Environmental Protection Agency is required to certify the Plant's compliance with radioactive waste disposal standards prior to operation.

The Department of Energy, Carlsbad Area Office, commissioned the first joint Organisation for Economic Co-operation and Development, Nuclear Energy Agency and International Atomic Energy Agency review of the performance assessment in the Compliance Certification Application, which was submitted to the Environmental Protection Agency in October 1996. This joint international review will examine whether the post-closure assessment of the Waste Isolation Pilot Plant (WIPP) is technically sound, appropriate and in conformity with international standards and practices. Based on the preliminary results of the international review, the Department of Energy is optimistic that the final report will be supportive of the technical approaches used to assess the post-closure performance of the Waste Isolation Pilot Plant disposal system. Therefore, the results of the report will be instrumental in our continuing effort to increase confidence in the WIPP and our mission to protect people and the environment from the hazards of defence generated transuranic waste.

Environmental Restoration

The mission of the Office of Environmental Restoration is to protect human health and the environment from risks posed by contaminated facilities and land areas held by the Department of Energy. This endeavour is accomplished through remediation of contaminated sites and facilities, which include soil, ground water, surface water, structures, and other material. Environmental Restoration also provides necessary landlord, oversight, surveillance and maintenance, and technical assistance in support of remediation, decommissioning, and assessment activities.

The activities managed by the Office of Environmental Restoration are driven by eight program priorities. The priorities are listed below in order of emphasis, not chronological occurrence:

- Reduce off-site contamination
- Prevent contamination migration
- Remediate non-Departmental sites and facilities
- Reduce on-site contamination
- Maintain the essential infrastructure cost-effectively (e.g., site safety, utilities, maintenance, etc.)
- Make prudent business decisions
- Release facilities and land for public use
- Reduce uncertainty through characterisation

The Environmental Restoration program is divided into five program areas: the Formerly Utilised Sites Remedial Action Program (FUSRAP), Uranium Mill Tailings Remedial Action (UMTRA) project, other small sites, large sites remedial action, and large sites decommissioning.

The UMTRA project manages the cleanup of 24 former uranium ore processing sites contaminated with tailings and other wastes from uranium milling operations. In addition to the processing sites, mill tailings remediation also has been completed at more than 5,000 vicinity properties.

Under FUSRAP, remedial actions are conducted at 46 sites where the Federal Government has contracted with private firms to process material or perform atomic weapons research and development. Environmental Restoration also has identified hundreds of vicinity properties requiring cleanup. All FUSRAP sites are projected to be complete by 2016.

There are 47 other small sites in the Environmental Restoration program. These small sites are not managed under the UMTRA or FUSRAP programs. The major objective of this program area is to focus resources on the cleanup of all release sites and facilities that pose the highest risk to the public and/or the environment by FY 2000.

Remedial actions at large sites are performed to contain contamination and to mitigate risk to human health and the environment. There are 15 large sites in the Environmental Restoration program. The large sites program area includes over 7,300 individual release sites that require characterisation and potential remediation. The major objective of this program area is to remediate all release sites that present a high relative risk by 2,000.

Science and Technology

The Office of Science and Technology conducts a national technology development program of applied research, development, demonstration, testing, and evaluation to furnish innovative technologies the will reduce risks to workers, the public, and the environment; reduce cleanup costs; or provide solutions to correct environmental problems for which solutions currently do not exist.

Environmental Management manages its technology development activities around five major focus areas: Mixed Waste Characterisation, Treatment, and Disposal; Radioactive Tank Waste Remediation; Subsurface Contaminant's; Decontamination and Decommissioning and Plutonium. Other crosscutting activities such as robotics; efficient separations; characterisation, sensors, and monitors; industry and university programs; and technology integration also are conducted in support of the Focus Areas.

Responsibility for co-ordinating development of mixed waste technologies is centralised at Idaho, radioactive tank waste at Hanford, contaminant plumes and landfill stabilisation at Savannah River, and decontamination and decommissioning at the Federal Energy Technology Center at Morgantown.

Successful implementation depends on addressing concerns of stakeholders, involving industry early in the development process, and achieving commercial availability. Supporting assessments of innovative technologies can facilitate the implementation process by including site users, regulators, and stakeholders. The Office of Science and Technology provides the Environmental Management focal point for technology transfer activities with other countries and international organisations.

Nuclear Material and Facility Stabilisation

The end of the Cold War has resulted in a dramatic increase in the number of surplus facilities and nuclear and non-nuclear materials requiring focused management. In their current condition and form, the facilities and various materials (e.g., plutonium and other special nuclear materials, uranium, spent nuclear fuel, and a myriad of chemicals) individually and in combination present a potential risk to site workers, the public, and the environment.

To address and control this risk, the Office of Nuclear Material and Facility Stabilisation has delineated a three-part objective: stabilise large quantities of nuclear materials, including spent fuel, to place them in a condition appropriate for continued storage; deactive surplus facilities to reduce existing risks and thus the maintenance "mortgage" of these facilities; and prepare materials for ultimate disposition. To support and ensure success in these mission activities, the program conducts facility surveillance and maintenance.

The Nuclear Material and Facility Stabilisation program also is responsible for providing safeguard and security support to the entire Environmental Management program. Based on the current inventory of materials and facilities in the program, it is projected that the Nuclear Material and Facility Stabilisation mission will be complete by 2010.

The program is based at major facilities in California, Colorado, Florida, Idaho, Ohio, South Carolina, Tennessee, and Washington. It is board in scope, encompassing:

- 13 nuclear reactors
- 41 radioactive processing facilities
- 3,000 surplus buildings contaminated with or containing radioactive, hazardous, and toxic materials
- 39 million liters of acids containing radioactive contaminants
- 2,700 metric tons of spent nuclear fuel
- several thousand kilograms of plutonium in various forms and locations
- 37,000 packages of plutonium materials and related waste products
- 75 million curies of cesium and strontium

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.

In 1996, Nuclear Material and Facility Stabilisation undertook to reduce risks by stabilising nuclear and other materials and spent fuels, as recommended by the Defence Nuclear Facilities Safety Board at the Hanford Site, the Savannah River Site, and other sites. These materials are located in spent-fuel storage pools, reactor basins, reprocessing canyons, and various facilities once used for processing and manufacturing nuclear weapons.

The Spent Nuclear Fuel program, under the Office of Nuclear Material and Facility Stabilisation, is responsible for stabilising and safely, reliably, and efficiently storing the current and future inventory of Department-owned spent nuclear fuel until a disposal facility becomes available. Spent nuclear fuel consists of nuclear materials or heavy metals such as uranium, plutonium, or thorium withdrawn from nuclear reactors or other neutron irradiation facilities.

The Department currently owns and stores approximately 2,700 metric tons of heavy metal at a number of locations throughout the country. Most of this spent nuclear fuel is stored in facilities at the Hanford Site in Richland, Washington; the Idaho National Engineering Laboratory in Idaho Falls, Idaho; The Savannah River Site in Aiken, South Carolina; and the West Valley Demonstration Project in West Valley, New York. A permanent disposal facility is not expected to be ready to accept Department-owned spent nuclear fuel before 2016.

Specific actions to reduce risks and costs are planned during the interim storage period. By December 1999, the spent nuclear fuel at the Hanford K-Basins will be conditioned, placed in a new canister storage building, and stored there until its transfer to a repository. The spent nuclear fuel at the Idaho National Engineering Laboratory, including Three Mile Island fuel, will be removed from wet storage in the chemical processing plant, consolidated, and then stored by December 1999. At the Savannah River Site, some fuel in storage at the receiving basin for off- site fuels and the K- and L Basins is planned to be processed. The site has accelerated the identification of technologies that could be used to prepare spent fuel for ultimate disposal.

Deactivation is the process of placing surplus facilities in a safe and stable condition and, through these risk reduction actions, reducing the long-term surveillance and maintenance costs. Deactivation can include, but is not limited to, removing nuclear fuel; de-energising nonessential systems; making necessary structural modifications/repairs; and removing radioactive and hazardous materials, including conducting limited decontamination. Nuclear Materials and Facility Stabilisation is also responsible for implementing certain functions not directly related to shut-down and clean up activities. Specifically, in 1996, a significant step was made with the establishment of a new nuclear weapons non-proliferation policy concerning foreign research reactor spent nuclear fuel. Under this new policy, the United States will accept, over a 13-year period, up to approximately 20 metric tons of spent nuclear fuel from 41 countries. Only spent fuel containing uranium enriched in the United States is covered under this policy. This policy is also key to continued commitment and participation of research reactor operators in the Reduced Enrichment for Research and Test Reactors (RERTR) program. The RERTR program encourages reactor conversion from highly enriched uranium fuels to low-enriched uranium fuels.

The spent fuel will be managed at the Savannah River Site, South Carolina, and the Idaho National Engineering Laboratory, Idaho. The first spent fuel shipment under the new policy was made in September 1996 to the Savannah River Site from reactors in South America (Columbia and Chile) and Europe (Germany, Sweden, and Switzerland).

Public Accountability

Environmental Management continues working toward enhancing partnerships with its stakeholders. The Environmental Management Advisory Board, comprised of individuals representing

Federal and local environmental agencies, corporations, universities, and other organisations, advises the Assistant Secretary as an unofficial "board of directors."

Environmental Management also has established site-specific advisory boards to provide the public with a forum to express its recommendations and concerns. The boards are made up 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 groups. Board members recommend options to resolve difficult issues facing the Environmental Management program, including site-specific cleanup criteria and risk assessment, land use, priority setting, management effectiveness, cost-versus-benefit analyses, and strategies for site waste management and disposal facilities.

Site Operations

The Office of Site Operations; mission is to serve as an advocate and provide policy direction for landlord planning and budgeting, including reducing site infrastructure costs and managing workforce restructuring for Environmental Management. The Office serves as the focal point for DOE-wide programs for transportation management, emergency management, characterisation management, pollution prevention, and waste minimisation.

I .17.2 U.S. Nuclear Regulatory Commission (NRC)

Repository Program Activities

In FY 1996, the NRC completed a comprehensive evaluation of its prelicensing program as a result of severe budget reductions, revisions to DOE's program, and recommendations of the National Academy of Sciences regarding Yucca Mountain HLW disposal standards. Consequently, the NRC significantly redirected its high-level waste (HLW) management program to focus on resolving the 10 issues most significant to repository licensing. Other activities necessary for eventual licensing have been deferred as a result of budget reductions. In FY 1997, budget reductions resulted in eliminating contractor support for 3 out of the 10 key technical issues. In the face of declining budgets, the key technical issues approach optimises the use of limited resources by focusing on those issues most significant to repository performance.

Regulatory Development Activities

In the Energy Policy Act of 1992 (the Act), the Environmental Protection Agency (EPA) is directed to promulgate health-based standards for protection of the public from releases of radioactive material from a repository at Yucca Mountain. As directed by the Act, EPA contracted with the U.S. National Academy of Sciences (NAS) to conduct a study and provide recommendations to the EPA on the appropriate technical basis for each such standards. Although the NAS could consider a range of issues, its recommendations must 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 of 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 report was issued on August 1, 1995. NRC is currently co-operating with the EPA to ensure the development of reasonable and implementable HLW standards specific to Yucca Mountain, considering the recommendations of the NAS. In addition, NRC is developing options for Commission consideration for a strategy to revise NRC's HLW regulations.

NRC also completed a rulemaking, in response to a petition from DOE, to provide design criteria for repository structures, systems, or components necessary to prevent or mitigate the consequences of accidents that may have potentially serious consequences during the operational period of the repository.

Finally, guidance (NUREG-1563) was completed on the use of expert elicitation, which provided DOE timely input for its ongoing and planned expert elicitations.

Prelicensing Issue Resolution Activities

During this prelicensing period, for the key technical issues, NRC will identify potentially significant vulnerabilities for licensing and notify DOE prior to its FY 1998-1999 viability assessment. NRC plans to comment on DOE's viability assessment and on DOE's recommendation to the President regarding the sufficiency of site characterisation and waste form adequacy.

Overall, for most of the KTIs, activities in FY96 concentrated on establishing a sound technical basis for future issue resolution during FY97 (see NRC High-Level Radioactive Waste Program Annual Progress Report, Fiscal Year 1996, B. Sagar, ed., NUREG/CR-6513, No. 1, U.S. Nuclear Regulatory Commission, Washington, D.C.). Activities included data collection to improve the understanding of parameters or processes, refining or completing development of models and associated computer codes representing various repository subsystems or processes, performing limited sensitivity/importance analyses on selected topics. Examples of significant progress toward issue resolution include: narrowing the range of tectonic models, identifying an acceptable seismic design methodology, and total system performance assessment.

Central Interim Storage Activities

Passage of implementing legislation for central interim storage is uncertain. Proposed legislation was introduced in the Senate during January 1997. NRC regulations regarding the transportation and storage of spent nuclear fuel are in place and are being effectively implemented. The regulations regarding storage of spent nuclear fuel are suitable for the licensing of a central interim storage facility.

The DOE has proposed submitting a topical (generic) safety analysis report for a proposed central interim storage facility at an unnamed location. The DOE and NRC staffs have met to discuss the administrative and technical aspects of this report. DOE intends to initially store spent fuel in NRC-approved packages and is preparing the topical report to be inclusive of a number of design parameters. DOE expects to submit the topical report for NRC review in May 1997. After the NRC review of the topical safety analysis report, DOE may submit an application for a site depending on the resolution of several policy issues.

The Goshute Tribe in Utah has entered into an agreement with 11 utilities to build a storage facility on its Utah reservation. This is similar to the failed Mescalero Apache initiative. Although there has been a significant amount of discussion and interest regarding a central interim storage facility by several organisations, no application has been submitted by any party. The NRC is prepared for a submittal of an application for a central interim storage facility.

I .17.3 U.S. Environmental Protection Agency (EPA)

Environmental standards for the management and disposal of spent nuclear fuel, high-level and transuranic radioactive wastes (40 CFR Part 191) were established by EPA in 1985. In 1987, a Federal court vacated and remanded the disposal portion of Part 191 to the Agency. The EPA was

working to re-establish those standards when, in 1992, the Waste Isolation Pilot Plant (WIPP) Land Withdrawal Act was enacted. It reinstated most of the standards but required repromulgation of the sections which dealt with individual dose limits and protection of ground water. This repromulgation was finished with publication of the amendments in December 1993. The WIPP Land Withdrawal Act also gave EPA the role of certifying compliance of the WIPP facility with Part 191 and many other environmental standards and regulations. In February 1996, EPA issued its final criteria for certifying WIPP compliance with disposal regulations. And, finally, the Land Withdrawal Act exempted Yucca Mountain from the Part 191 standards.

Also in 1992, the Energy Policy Act was enacted. This Act gave EPA the authority and responsibility to issue environmental standards for Yucca Mountain specifically. The Act also directed EPA to contract with the National Academy of Sciences to study several issues posited by the Congress and to report to EPA with guidance and recommendations for the contents of the Yucca Mountain standards. This study was completed in August 1995. The EPA then began a rule- making, taking the NAS study into account, to set environmental standards for Yucca Mountain. The Act set a deadline for one year after receipt of the study for standards to be finalised. The proposed standards are expected to be published this spring (1997).

EPA is also continuing its program to develop generally applicable environmental radiation standards for the management and land disposal of low-level radioactive wastes that will be focused on Federal facilities. Primary components include sections on management and storage, disposal performance, protection of underground sources of drinking water, and qualitative assurance requirements. A formal proposal is expected in the fall of 1997.

Further information can be obtained from: *Mr. J. Saltzman, Director, Office of External Relations, Office of Civilian Radioactive Waste Management, US Department of Energy, Forrestal Building, RW-5, Washington D.C. 20585, [Tel: +1 (202) 586 2277, Fax: +1 (202) 586 7259]; or from Mr. M. Knapp, Deputy Director, Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission, Washington D.C. 20555, [Tel: +1 (301) 415 7358, Fax: +1 (301) 415 5371, E-mail: mrk@nrc.gov].*

II INTERNATIONAL ORGANISATIONS ACTIVITIES
ACTIVITÉS DES ORGANISATIONS INTERNATIONALES

II .1 INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

II .1.1 General

Convention on the safety of radioactive waste management

An open-ended group of legal and technical experts has met on six occasions to identify the main legal and technical elements necessary in an "incentive convention" on the safety of radioactive waste management. Participants from 61 countries and observers from the Commission of the European Communities, OECD/NEA, UNEP (Secretariat of the Basel Convention) and WHO have attended at least one meeting of the group.

Using the structure of the Convention on Nuclear Safety as a model, the group – under the chairmanship of Professor A.J. Baer, former Deputy Director of Switzerland's Office Fédéral de

l'Énergie – has made good progress, agreeing on many provisions which would be included in the envisaged convention. Among the questions requiring further discussion are: whether the convention should cover the safety of spent fuel management (notably when the spent fuel has been removed from the reactor site and designated for reprocessing or it has been removed from the reactor site but no decision as to its further use has been taken); how the convention should cover radioactive waste resulting from military operations; and the safety of transboundary movements of radioactive waste.

It is hoped that agreement will be reached on the contents of the Convention in the course of 1997.

Symposium on "Experience in the Planning and Operation of Low Level Waste Disposal Facilities"

An international symposium on "*Experience in the Planning and Operation of Low Level Waste Disposal Facilities*" was held from 16 to 21 June 1996 in Vienna with the objective of reviewing and summarising the experience gained world-wide in implementing low level waste disposal from initial planning until final closure. The symposium, attended by 114 people from 46 Member States, comprised 58 presentations covering topics on regulation and licensing, infrastructure and planning, siting, disposal systems in the operational and post-operational phases, and safety assessment. Open discussions were held on reassessment of past disposal practices, and adequate approaches for disposal in developing countries. It showed that LLW disposal is based on mature and well demonstrated technologies. However, many industrialised countries face difficulties in implementing LLW disposal mostly due to public concern and opposition. It was also noticed that technology transfer is required to provide developing Member States with cheaper but adequate and safe disposal solutions.

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

The Contact Expert Group (CEG) was established by a group of interested IAEA Member States under the auspices of and secretarial support from the IAEA to assist them in co-ordinating their efforts regarding the support to the Russian Federation in waste management issues. At present the CEG consists of eleven "full" members (Belgium, France, Finland, Germany, Norway, Russian Federation, Sweden, UK, USA, European Union and International Institute for Applied Systems Analysis-IIASA) and three observers (Japan, Nordic Environmental Finance Corporation-NEFCO and International Science and Technology Center – ISTC). Such a forum was considered to help avoid duplication, assure that priorities are properly assessed and made known to the international community. Since its first meeting in March 1996 the CEG met two times (Vienna and Brussels). The latter meeting resulted in a number of important, action oriented decisions and recommendations directed to strengthening co-operation in the most important high priority areas.

Peer reviews

In response to a request from the French authorities, the Agency convened an international team of experts to review the short lived waste management programme and activities, both planned and implemented, in France as seen through the experience at the Centre de l'Aube. Based on source material provided by ANDRA (Agence nationale pour la gestion des déchets radioactifs, France), the team made an evaluation of the programme and formulated recommendations in several areas such as verification, control and testing, and safety assessment. A report has been prepared and will be sent to the French authorities.

Upon request of the US DOE's Carlsbad Office the IAEA agreed to organise jointly with OECD/NEA a peer review of DOE's Compliance Certification Application to the Environmental Protection Agency related to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. For the purpose of organising this review a joint secretariat was established between the IAEA and the OECD/NEA. The primary source material for the review was the Title 40 CFR 191 Compliance Certification Application, Volume I. Review meetings have been held and the final report is being prepared.

II .1.2 Waste Safety

The work of the International Atomic Energy Agency's (the Agency) Department of Nuclear Safety has been recently described under three headings:

- Legally binding international safety agreements such as various conventions which have been adopted or are still being developed (see section A above);
- Non-binding international safety standards which have been developed mainly under the auspices of the Agency; and
- Provisions for the application of those standards.

It is convenient to report the highlights of the work of the Waste Safety Section under these headings.

Establishment of International Safety Standards

Background

Under Article III.A.6 of its statute, the Agency is authorised to establish or adopt standards of safety in collaboration with the competent organs of the United Nations and with the specialised agencies concerned, and since the Agency's inception the Secretariat has been involved in developing and setting such standards.

In 1991, the Agency established the Radioactive Waste Safety Standards Programme (RADWASS). In 1996, following a review, the programme was modified and documents are now being prepared under the following headings: (1) general topics; (2) pre-disposal; (3) discharges; (4) disposal; (5) environmental restoration.

The hierarchy of Agency safety standards documents

In 1989, the Secretariat introduced a hierarchical structure for IAEA Safety publications. This structure has recently been modified and the documents series is now termed "*the Safety Standards Series*". The documents are now exclusively regulatory in their nature and are divided into: Safety Fundamentals, Safety Requirements and Safety Guides.

Safety Fundamentals

Publications in the Safety Fundamentals category, which are primary text for other IAEA Safety Series publications, state the basic objectives, concepts and principles involved in ensuring protection and safety in the development and application of atomic energy for peaceful purposes. The Safety Fundamentals document "*The Principles of Radioactive Waste Management*", which is the leading waste management document, was published in 1995.

Safety Requirements (formerly "Standards")

Publications in the Safety Requirements category specify basic requirements that must be satisfied in order to ensure safety for particular activities or application areas. These requirements are governed by the basic objectives, concepts and principles that are stated in Safety Fundamentals.

The written style used in Safety Requirements accords with that of regulatory documents since the requirements which they establish – and which are mandatory as far as the Agency's own operations are concerned – may be adopted by Member States, at their own discretion, for use in the national regulations to be applied in respect of their own activities. Regulatory requirements are expressed as "shall" statements. In the RADWASS programme, Safety Requirements on pre- disposal, discharge to the environment and near-surface disposal are currently being developed. A Safety Requirement on "*Establishing a National System for Radioactive Waste Management*" was issued in 1995.

Safety Guides

Publications in the Safety Guides category supplement Safety Requirements by presenting recommendations, based on international experience, regarding measures to ensure the observance of Safety Requirements.

Also, Safety Guides may establish specific requirements that are consequential to a basic requirement of a Safety Requirement. In addition, they may provide recommendations on measures to fulfil such subsidiary requirements, the recommendations being presented as "should" statements.

Safety Guides may be less formal in written style than Safety Requirements and may contain more explanatory and background information. They may consist largely of such information when this is necessary for the interpretation of a Safety Requirement. Several Safety Guides are presently under development in the RADWASS programme in support of the Safety Requirements mentioned above.

Safety Standards Review Process

The Secretariat has introduced a uniform preparation and review process covering all safety areas. To this end, it has created a set of advisory bodies with harmonised terms of reference to assist in preparing and reviewing all documents – namely, the Advisory Commission for Safety Standards, the Nuclear Safety Standards Advisory Committee, the Radiation Safety Standards Advisory Committee, the Waste Safety Standards Advisory Committee and the Transport Safety Standards Advisory Committee. It has assigned to each of these bodies a Scientific Secretary who co-ordinates the work of the body with the relevant Agency policies and programmes, and it appoints a Technical Officer for the preparation of each document in accordance with recommendations made by the Advisory Commission for Safety Standards and the relevant Advisory Committee.

Working Group on Principles and Criteria for Radioactive Waste Disposal

Established in 1991, this Working Group has met annually under the chairmanship of Mr. K. Bragg (Canada) and has provided a forum for the discussion of unresolved issues related to the disposal of radioactive wastes.

In 1994 it issued its first report "*Safety Indicators in Different Timeframes for the Safety Assessment of Underground Radioactive Waste Repositories*" (IAEA-TECDOC-767).

The second report of the Working Group "*Issues in Radioactive Waste Disposal*" (IAEA-TECDOC-909) was published in 1996. It contains three position papers on: Post-Closure Issues, Optimisation of Radiation Protection – a review of its application to radioactive waste disposal, and Interface Issues Between Nuclear Safeguards and Radioactive Waste Management.

At present, a position paper on "*Regulatory Decision Making in the Presence of Uncertainty*" is under review by the Group.

Providing for Application of Safety Standards

Radiological Assessments

At the request of Member States and pursuant to its statutory obligation to provide for the application of its safety standards, the Agency has in recent years organised a wide variety of international radiological assessments. Four such radiological assessments are currently underway or nearing completion. Three are related to radioactive residues from nuclear weapons testing (the studies of the radiological situations at Bikini Atoll, Semipalatinsk (Kazakstan) and the Atolls of Mururoa and Fangataufa), the other to radioactive residues from the nuclear propulsion of submarines and icebreakers (The International Arctic Seas Assessment Project (IASAP).

Work on the IASAP project was completed in 1996 and an Executive Summary of the report of the study was provided to the Contracting Parties to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention 1972) in January 1997.

The International Arctic Seas Assessment Project

Background

The IASAP project was launched in 1993 to address concern over the potential health and environmental impacts of radioactive waste (including spent fuel in six submarine reactors and in a fuel assembly from an icebreaker reactor) dumped in the shallow waters of the Kara and Barents Seas, near the Novaya Zemlya nuclear test site. The IASAP project was executed in connection with the Agency's responsibilities under the London Convention 1972, and the progress of the IASAP project has been reviewed each year by a group of senior scientists who were responsible for preparing the final IASAP report. The major conclusions of the project can be summarised as follows:

Present radiological impact

Monitoring surveys in the vicinity of the dumped wastes have shown only a very small and localised leakage from the wastes. The present radiological impact of the dumped wastes is negligibly small.

Predicted future radiological impact

The results of critical group dose and collective dose calculations performed on the basis of predicted radionuclide release indicate that on the global and regional scale, the future risks to human health and the environment associated with the dumped waste are extremely low. The calculations show that the future radiation doses to members of the indigenous population groups living on the northern coast of Russia are likely to be trivial. The future doses to one of the potentially critical groups, soldiers patrolling the shores of the bays of Novaya Zemlya (the actual dumping sites), are expected to be somewhat higher – but not dissimilar to general background levels.

Remedial actions

The feasibility and costs of potential remedial actions, such as the in situ capping or retrieval of the major dumped objects, have been assessed for one test case, as have the associated doses to the workforce carrying out the remediation. The costs would be very high relative to the possible avertable doses. On the other hand, if the remedial actions were taken for reasons other than radiological protection ones, the associated exposure of the workforce would probably not be significant.

Other projects

In October 1996 the Agency launched a new project on Biosphere Modelling and Assessment Methods (BIOMASS) as a successor to the previous international projects in this field (VAMP and BIOMOVS).

One part of BIOMASS is concerned with biosphere modelling related to radioactive waste disposal and, specifically, the development of the "Reference Biosphere" concept. With the objective of ensuring that the Reference Biosphere project is developed taking account of the views of the relevant scientific and technical disciplines, arrangements have been made for regular interaction with the IAEA Working Group on Principles and Criteria for Radioactive Waste Disposal and the NEA Performance Assessment Advisory Group (PAAG).

II .1.3 Waste Technology

International Radioactive Waste Technology Advisory Committee

The Director-General of the IAEA established an International Radioactive Waste Technology Advisory Committee (WATAC) as a standing body of senior experts in radioactive waste management. WATAC provides advice to the Secretariat on the waste technology programme and reviews technologies related to the management of radioactive waste. WATAC, with experts from 16 countries and observers from two international organisations, will meet annually and the first meeting was held end of October 1996.

Training Courses and Technical Co-operation Workshops

In co-operation with national authorities the IAEA developed and prepared in 1996 several courses on the management of radioactive waste:

- An interregional training course in Saclay (9 September-4 October) on management of waste from NPPs;
- A regional course in Paks (Hungary), on specific problems in the management of waste from WWER plants;
- An interregional training course in Cumbria (UK) on near surface disposal of LILW.

Several Technical Co-operation activities with developing Member States have been continuously managed by the IAEA. The Regional Project on Planning and Management of Decommissioning WWER-type NPPs is worth mentioning. The project emphasis is on WWER-440 reactors for which little consideration had been devoted to decommissioning at the plant design and construction stage, and little emphasis has been placed on planning for decommissioning. The situation is currently evolving in the right direction, partly as a result of IAEA efforts. Workshops were held in Greifswald, Germany and in Hungary, which included a peer review exercise of the Paks NPP preliminary decommissioning plan.

Completed and newly initiated Co-ordinated Research Programmes

Among the several co-ordinated research programmes (CRPs), two were completed in the area of waste treatment and conditioning:

- Treatment Technologies for LILW from Nuclear Applications;
- Waste Treatment and Immobilisation Technologies Involving Inorganic Sorbents.

In the area of waste disposal the following new CRP's have been initiated:

- Extrapolation of Short Term Observations to Time Periods for Isolation of Long- lived Radioactive Waste;
- Anthropogenic analogues for geological disposal of high-level and long lived radioactive waste
- Long Term Behaviour of Low and Intermediate Level Waste Packages under Repository Conditions.

Regional Center for "Demonstration of Predisposal Waste management Methods and Procedures"

To improve the technical knowledge and practical skill in the management of radioactive waste generated by the use of nuclear techniques in medicine, research and industry the IAEA is supporting regional demonstration centers for "Demonstration of Predisposal Waste Management Methods and Procedures." The first demonstration, which has provided hands-on practice for participants from Greece, Syria and Albania, was held in Turkey in May 1996. The first demonstration in Latin America is scheduled in Chile in May 1997 and a second demonstration in Turkey is scheduled for June 1997.

Conditioning of radium sources

During the first IAEA supported radium conditioning operation in Uruguay 59 GBq (1586 mg) of radium sources were enclosed in 31 stainless steel capsules, emplaced in lead shields and finally contained in four specially prepared 200 liter drums for interim storage. There are plans for further conditioning operations in Latin America as well as in other parts of the world.

Development of indicators of sustainable development related to radioactive waste management

In April 1995, the Commission on Sustainable Development approved the programme of work and called upon the organisations of the UN system, with support of other intergovernmental and non-governmental organisations, and through the co-ordination of DPCSD, to implement elements that programme of work, including inter alia: 1) enhancement of information exchange among interested actors, 2) development of methodology sheets to be made available to Governments, 3) training and capacity building at the regional and national levels; 4) testing of an appropriate combination of indicators and monitoring of experience in a few countries; 5) evaluation of indicators, including adjustments, as necessary; 6) identification and assessment of linkages between the economic, social, institutional and environmental elements of sustainable development. The IAEA was proposed as the lead organisation for the implementation of the programme of work in the field of radioactive waste management. In mid 1996, the IAEA submitted its first draft of indicators and a methodology sheet for radioactive waste management. The list of proposed indicators will be further defined and methodology sheets for each will be developed in a consultants' meeting planned for the end of March 1997.

Joint EC/IAEA/NEA Project to Produce a Common List of Cost Items for the Decommissioning of Nuclear Facilities

The second meeting of the project group (composed of scientific secretaries from the EC, IAEA, and NEA plus a project co-ordinator convened in June 1996 at the IAEA Headquarters in

Vienna. The purpose of the meeting was to discuss related programmes in the respective organisations and determine the direction and tasks of the joint project. Further, a revised project plan for this joint effort was discussed and agreed.

II .1.4 Future Agency Sponsored International Meetings

- International Symposium on Nuclear Fuel Cycle and Reactor Strategy: Adjusting to new realities, June 3-6 1997 (Vienna).
- Seminar on Approaches and Practices in Strengthening the Nuclear Safety, Radiation Protection and Waste Management Infrastructure in countries of eastern Europe and the former USSR (planned fall 1998, Vienna).
- Specialists Meeting on Application of the Concepts of Exclusion, Exemption and Clearance: Implications for the Management of Radioactive Materials, Vienna, 6-9 May 1997.
- International Conference on Low Doses of Ionising Radiation: Biological Effects and Regulatory Control, Seville, Spain, 17-21 November 1997 (sponsored by: IAEA, WHO, in co-operation with UNSCEAR).

II .1.5 Recent Publications

YEARBOOK *Nuclear power, nuclear fuel cycle and waste management: Status and trends* (1996) [STI/PUB/1018].

PROCEEDINGS *Planning and operation of low level waste disposal facilities.* Proceedings of a Symposium, Vienna, June 1996 (1997) [STI/PUB/1002].

TECDOC-911 *Processing of nuclear power plant waste streams containing boric acid.*

TECDOC-909 *Issues in radioactive waste disposal.* Second report of the Working Group on Principles and criteria for radioactive waste disposal.

TECDOC-904 *Validation of models using Chernobyl fallout data from southern Finland.* Scenario S. Second report of the VAMP Multiple Pathways Assessment Working Group.

TECDOC-895 *Application of quality assurance to radioactive waste disposal facilities.*

TECDOC-864 *Requirements and methods for low and intermediate level waste package acceptability.*

TECDOC-857 *Modelling of radionuclide interception and loss processes in vegetation and of transfer in semi-natural ecosystems.* Second report of the VAMP Terrestrial Working Group.

TECDOC-855 *Clearance levels for radionuclides in solid materials.* (Application of exemption principles – Interim report for comment).

II .2 COMMISSION OF THE EUROPEAN COMMUNITIES (CEC)

II .2.1 General

The specific R&D programme on "Nuclear Fission Safety" (1994-1998) under the Euratom framework programme (Council Decision 15.12.1994, 94/920 Euratom, Official Journal L361 – 31.12.1994) has been implemented by a single call with two deadlines for submission of the proposals on shared-cost projects (20 March 1995 and 28 February 1996 respectively) while the call on 'Concerted Actions' is continuously open until 1 November 1997.

The programme includes research on reactor safety, radioactive waste management and disposal and decommissioning as well as radiation protection. The budget for this programme is about 170.5 MECU.

On the proposals received at the 1st and 2nd deadlines, the Commission has selected 198 proposals for which a total EC contribution of 130 MECU is foreseen. Most of the selected projects have now started.

Results of the fourth 5-year R&D programme on "*Management and Storage of Radioactive Waste*" (1990-1994), have been presented at the 4th European Community Conference on "*Radioactive Waste Management and Disposal*", held in Luxembourg on 25-29 March 1996. The proceedings will be published with the EUR N° 17543.

A list of Publications will be laid out for consultation at the RWMC. Participants wishing to obtain reports are requested to transmit the EUR number of the report and their names plus forwarding addresses.

The Commission is currently preparing the 5th Framework programme (1998-2002).

II .2.2 Research Projects

The relevant main R&D topics concerning radioactive waste management and disposal and decommissioning are:

- Safety Aspects of Waste Disposal (C 1)
- Field Experiments in Underground Research Facilities (C 2)
- Research on Basic Phenomena (C 3)
- Decommissioning of Nuclear Installations (C 4)

II .2.2.1 Safety Aspects of Waste Disposal (C 1)

The 'Spent Fuel Performance Assessment (SPA)' project covers all elements needed to come to a total system analysis of spent fuel in various host rock formations (clay, crystalline rocks and salt formations) be covering the near-field, far-field and biosphere.

It will be based on sharing the experiences, assessment tools and data bases in use and under development in the different national programmes to come closer to a common understanding and harmonisation of the assessment methodologies and practices in the Member States dealing with the safe disposal of spent fuel.

The project, co-ordinated by CEA-IPSN (F), involves partners from organisations in Belgium, Finland, France, Germany, The Netherlands and Spain.

II .2.2.2 Field Experiments in Underground Research Facilities (C 2)

The European Commission is continuing to support large field experiments in the HADES underground facility in the Boom clay beneath Mol in Belgium and in the Asse salt mine in Germany. Moreover it has started co-funding a large demonstration project, FEBEX, at the Grimsel Test Site in Switzerland.

These projects concern respectively :

HADES facility, Mol (B)

- Investigation of the clay response on the excavation of a tunnel in the clay (CLIPEX),
- Analysis of the combined effects of heat and radiation on the clay (CERBERUS),
- Demonstration test for sealing of a repository in clay (RESEAL),
- Corrosion test on active HLW glass (CORALUS),
- Investigation on the influence of organic matter and complexation on radionuclide migration (TRANCOM CLAY).

The Asse salt mine (D)

- Investigation on the behaviour of crushed salt used as backfill material in the gallery waste emplacement concept (VSS),
- Tests on the use of crushed salt as buffer and sealing material in the borehole disposal concept (DEBORA),
- Convergence measurements in a deep dry drilled borehole.

The Grimsel Test Site (CH)

- Demonstration test on the construction of the engineered barrier system of a repository in granite and study of the thermo-hydro-mechanical processes in the near-field (FEBEX project).

Whereas the Commission stimulates international Cupertino and optimum use of these research facilities, both research organisations from the host countries Belgium, Germany, Switzerland and from France, Spain and the United Kingdom are participating in the above mentioned projects. Moreover the Commission has established a CLub of Underground Storage, TEsting and Research facilities (CLUSTER), aiming at intensifying exchange of information.

II .2.2.3 Research on Basic Phenomena (C 3)

Under this topic the European Commission is supporting a number of international projects concerning waste minimisation, waste characterisation, rock mechanics, gas generation and gas flow, radionuclide transport and retardation processes, natural analogue and palaeohydrogeology and geoforecasting. Below some of these projects are mentioned.

Waste volume minimisation (C 3.1)

Under this topic aiming to develop management schemes and treatment methods which permit i.a. waste decategorisation by extensive decontamination processes, the Commission is supporting at present three projects:

- continuation of the demonstration of a mobile wet oxidation pilot plant to treat radioactive waste containing organics;
- development of novel highly selective inorganic crystalline ion exchange materials for the decontamination of aqueous nuclear waste effluents;
- synthesis of extractants based on calixarene and crown ether derivatives selective to strontium and actinides (actinides only in order to decategorise MLW).

Characterisation of waste forms and matrices (C 3.2)

Research projects under this issue aiming at the investigations and formulation of source terms for nuclear waste glass and spent fuel and involves the:

- compilation of relevant data on the leaching behaviour of the R7T7 glass (the Versail data base) under varying experimental conditions to evaluate the behaviour of significant radionuclides affecting long-term safety during glass alteration in different geological formations (glass matrix project);
- the quantification of processes controlling long-term dissolution/alteration of spent fuel and the associated radionuclide release under conditions which might prevail in underground repositories in granite, salt or clay formations (source term spent fuel project).

Quality control of nuclear waste packages and waste forms (C 3.3)

Projects under this topic should contribute to the establishment of a coherent QA/QC system for radioactive waste packages foreseen for both interim storage and final disposal. The activities cover:

- a "round robin" test for non-destructive assays of 200 litres radioactive waste packages, involving 10 organisations from 7 EU Member States;
- the improvement of localisation and quantification of neutron emitters in waste packages by passive and active neutron assay techniques;
- the development of fast, simple and standardised chemical analytical techniques for destructive radioactive waste control;
- the characterisation of accessible surface area of HLW glass monoliths by high energy accelerator tomography.

A "European Network of Testing Facilities for the Quality Checking of Radioactive Waste Packages" has been created in 1992 on the initiative of the Commission. At present, five working groups have been set up on: (i) non-destructive testing-gamma measurements, (ii) measurement of volatile releases from waste packages, (iii) Quality Assurance and Quality Control procedures, (iv) neutron assay for waste packages and (v) chemical and radiochemical destructive analyses.

Rock mechanics (C 3.4)

On the topic of modelling of thermo-hydro-mechanical behaviour of host rocks and engineered barriers, three different benchmark exercises are launched respectively on :

- unsaturated clays (Project CATSIUS-CLAY) with participation of eight organisations from six countries (B, E, F, I, S, UK),
- saturated clays (Boom clay) with five organisations from three countries (B, E, F),
- crushed salt (Project CS-CS) with six organisations from four countries (D, E, F, NL).

Moreover a project on microstructural and chemical parameters of bentonite determinants of waste isolation efficiency involving 4 organisations from 3 countries (D, FIN, S) is supported.

Gas generation and gas flow (C 3.5)

On this topic, the project PROGRESS : PROject of research into Gas generation and migration in radioactive waste REpository SystemS is co-funded as a follow-up of the PEGASUS project, in which about 15 organisations from six countries (B, D, E, FIN, I, UK) are participating. The research concerns theoretical and experimental studies on gas generation from LLW and ILW packages and gas migration through buffer materials and repository host rocks.

Radionuclide migration (C 3.6)

Under this topic two projects are launched:

- the project CARESS: the role of colloids in the transport of RN from a radioactive waste repository investigates in a combined experimental (lab. + field work) and modelling work whether colloids have critical impact on the RN transport and retention and how they should be treated in safety assessment calculation. It involves research groups from 11 organisations from 5 countries (D, E, F, I, UK);
- the project GESAMAC: Geosphere modelling, geosphere sensitivity analysis, model uncertainty in geosphere modelling, advanced computing in stochastic geosphere simulation investigates the treatment of different sources of uncertainties (scenario, structural, parametric and predictive) and sensitivity analysis in the field of modelling RN transport by involving 4 research groups from 4 countries (E, I, S, UK).

Natural Analogue Studies (C 3.7)

Under this topic three projects are supported:

- the OKLO project to provide data for repository PA models by considering near-field (source term), far-field (geosphere) and overall PA aspects, involving 13 organisations from 4 countries (DK, E, F, S);
- the Palmottu project to investigate the RN mobilisation/transport/ retardation aspects from the U-Th ore deposits along well defined groundwater pathways in a fractured crystalline rock environment in respect to PA requirements involving 11 organisations from 5 countries (E, F, FIN, S, UK);
- the Clay Thermal Analogue project to study the THM and THCM changes undergone by heated clay formations at three sites in F, I and UK to determine how applicable the field data are for studying PA issues of clay barriers. In this project 4 research teams from 3 countries (F, I, UK) are involved.

II .2.2.4 Decommissioning of nuclear installations (C 4)

Studies on decommissioning of nuclear facilities aim to develop the necessary technology and to collect and process relevant data. The three research topics are:

- Innovative dismantling techniques: development and demonstration of dismantling techniques for LWR pressure vessels at KRB-A (Gundremmingen), BR3 (Mol) and EWN (Greifswald); testing and evaluation of advanced cutting tools (LSI, CAMC and Nd-YAG Laser; remote dismantling techniques applied to a graphite/gas reactor, the WAGR (Windscale).
- Collection and processing of technological performance data: further development of the EC-DB-TOOL data base.
- Data base for Specific Waste Arisings, Doses and Costs of Decommissioning: collection and processing of data in EC-DB-COST.

Currently R&D activities in these topics are proceeding under ten contracts. The co-ordination of cost items and data base structure with IAEA and NEA for the decommissioning cost data bases is making good progress. A joint EC-NEA-Studsvik seminar on "*Melting and Recycling of Metallic Materials from Decommissioning*" will take place in Nyköping, Sweden on 11-13 June.

II .3 OECD NUCLEAR ENERGY AGENCY

II .3.1 Update on NEA Activities for Radioactive Waste Management

II .3.1.1 Radioactive Waste Management Committee (RWMC)

The RWMC held its 29th annual session in Paris, on 13-14 March 1997. It received briefings on NEA and other international activities and discussed its programme of work.

A major discussion item was the frequency, priority level, and practical implications of the RWMC being involved in peer reviews of national programmes in the field of safety assessment of deep repositories. It was felt that this activity helps national programmes move forwards in a tangible manner and the review reports provide good reference information on what is desired and what is feasible. Peer review requests will thus be accorded high priority. Having completed – on request of the USDOE and in co-operation with the IAEA – the review of the 1996 Performance Assessment of the Waste Isolation Pilot Plant, the NEA than organised the review of the SITE -94 study by SKI, the safety authority in Sweden.

At the basis of the RWMC working method is the dialogue between safety authorities and implementing agencies trying together to define – and help advance – the state-of-the-art in policy and technical issues connected to the safe disposal of the radioactive wastes. The dialogue is also extended to other NEA committees. An important workshop co-organised with the NEA's CNRA and CRPPH committees was recently held in Cordoba, Spain. The workshop dealt with "*Regulating the Long-term Safety of Radioactive Waste Disposal*" and the proceedings will be published by the Spanish authorities. Follow-up activities will be discussed at the upcoming meetings of the relevant committee.

A major advancing task of the RWMC is to illustrate the role of safety assessments in connection with the incremental process of decision-making in repository development, and to

describe the structure of a typical safety assessment procedure. Despite differences in national approaches and practices, the group on validation/confidence building in safety assessments (VC/B group) has identified a sufficiently general and common structure that will serve as a framework for a document describing practical methods for establishing confidence in safety assessments. A draft has been produced, but the document has not yet reached a stage where it can be distributed. In any event, this document will require the complementary input of practical, illustrative examples from relevant RWMC advisory groups before it is completed. The audience for the report will be a technical readership familiar with performance assessment of deep geological repositories.

The RWMC two main advisory groups are the PAAG and SEDE. The former deals with the issue of how to perform and document a safety analysis of a nuclear waste repository, the latter deals with the practical aspects of site characterisation. As many national programmes are shifting from a research phase to a development – and-demonstration phase for potentially suitable sites for deep geologic repositories, the need has arisen to more closely co-ordinate site characterisation and safety-analysis specialists, to integrate design and construction issues, and to look at the interfaces between the various components of the repository system. These needs are reflected in the current programme of work of these two groups. Major progress is noted below.

II .3.1.2 PAAG Group

Introduction

The main task of the Performance Assessment Advisory Group (PAAG) is to promote a satisfactory understanding in the field of safety analysis of deep repositories and, in particular, to identify the open issues where progress is most urgently needed. Typically, it is the PAAG specialists who, in their respective countries, are responsible for preparing and reviewing the safety analyses of the waste repositories, while the SEDE specialists contribute the geoscience foundation to those studies. While purely technical issues are relatively straightforward to assess, a more difficult question is how to provide confidence that the information and the analyses are adequate for the prediction of very long term safety.

At its annual meeting, the PAAG reviewed, as usual, the state-of-the-art in performance assessment, was briefed on the international progress in international non-NEA projects, and revised its own programme of work which, in the past few years, has been increasingly co-ordinated with that of SEDE.

PAAG Programme of Work

Besides providing an international forum for the exchange of information on issues relative to radioactive waste management, the PAAG is also covering, with side activities and working groups, several areas:

- The in-depth discussion of integrated, total system performance assessments applied to reference or site-specific repositories and already available (IPAG working group);
- Confidence building in the use of predictive models in PA (GEOTRAP project);
- Confidence building in the preparation of safety assessments (Validation/Confidence Building working group);
- Scenario analysis (Scenario development workshop, User group of the FEPs data base);
- Data gathering and elucidation of data and model quality in geochemistry (TDB project, Sorption Modelling project).

PAAG Recent Achievements and Initiatives

Integrated Performance Assessments Working Group (IPAG)

In a situation where PA studies are being used to defend present repository concepts and may soon be used in applications for the siting of deep repositories, it is of immediate interest to many NEA member organisations to increase the level of understanding of the existing performance assessment studies. The group is to discuss and compare recently published Performance Assessments as a means to systematically explore commonalties and differences in the present state-of-the-art in integrated PA-methodology. The commonalties define the state-of-the-art, and the differences may serve to highlight areas for further reflection and improvement.

As Phase-1 of the project, the Integrated Performance Assessments Working Group (IPAG) has completed a report on the lessons learnt from the analysis of 10 national IPA studies of deep repositories issued by safety authorities and implementing organisations over the past 7 years. These studies address repository concepts in crystalline rocks, salt, and unsaturated tuff as well as most of the waste forms presently considered for deep geologic disposal. The report will be readied for formal publication in 1997. New initiatives include a Phase-2 of the IPAG focused on the regulatory experience of reviewing IPAs. The work of the IPAG and the V/CB group will foster the dialogue between implementers and regulators and, in part, will follow up on issues identified during the Cordoba workshop mentioned in the section relative to the RWMC.

Validation/Confidence Building Working Group (V/CB)

"Model validation" and "confidence building" are two concepts that have been widely evoked and debated when addressing the question "To what extent can one be confident of the demonstration of long-term safety of a deep repository system?". This question poses itself naturally to developers and regulators, yet a level of reflection is missing whereby the different assessors who participated to these debates and in different forums put forward a joint view of the concepts of validation and confidence building. This task has been taken up by the NEA's ad-hoc working group on validation/confidence building (V/CB) composed of PAAG, SEDE, and RWMC members.

The group has met four times and a document structure has been established. Much of the effort by the ad-hoc group was devoted to improving their understanding of the role of, and the approach to, safety assessment within each country represented in the group. In particular, the following aspects were discussed:

- The incremental decision-making process in the development of a deep geologic repository;
- Within each decision-making step, the iterative process of evaluating and improving (i) the estimated safety and (ii) confidence in he safety assessment;
- The main elements of a safety assessment and their integration for the appreciation of the safety of the system;
- The regulatory criteria for safety and radiological protection;
- The interaction between implementers and regulators.

The work of the ad-hoc group has resulted in:

- A better understanding of the approaches to safety implemented in several countries;
- The identification of a typical, iterative approach to assessing safety;
- The definition of typical practices for safety assessment;
- The clarification of the concepts of confidence evaluation, confidence improvement, and confidence statement.

The above elements allow the definition of a general framework encompassing the various methods that have been implemented for the evaluation and the improvement of confidence in safety assessments. The draft document has not yet reached a stage where it can be distributed. In any event, it will require the input of practical, illustrative examples of confidence-evaluation and confidence-improvement practices in safety assessments.

Scenario Analysis and FEPs Data Base

The overall aims of PAAG are to assist in the development of methods and tools of high quality for the assessment of the safety of radioactive waste disposal systems, and to promote a balanced and coherent use of these methodologies within national radioactive waste disposal programmes.

An important stage in development is the identification and documentation of all the features, events and processes (FEPs) that may be relevant to estimating the long-term safety or performance. This activity provides a basis for the broader activity of selecting FEPs that should be included, and developing scenarios that should be evaluated, in quantitative analyses.

Discussions within PAAG and RWMC confirmed that scenario development is an area of high priority and particularly suitable for international co-operation. It was suggested that the development of an international database of features, events and processes would be a valuable activity and, in 1993, PAAG set up a Working Group to oversee the development of such a database.

The International Data Base on Features, Events, and Processes (FEP) for safety assessments has just been completed. Seven countries contributed to this project. The finalisation of this data base and, in the future, its updates, will help the various national programmes address the issue of completeness of the scenarios examined in safety assessments studies. Initiatives have been undertaken in order to (a) maintain and update the database, and (b) produce a document on the state-of-the-art in scenario development following an ad-hoc workshop.

The database consists of two main parts, which are

1. ***The International FEP List*** – a comprehensive and structured list of factors relevant to the assessment of long-term safety of nuclear waste repositories.
2. ***Project Databases*** – a collection of FEP lists and databases, with references, compiled during repository safety assessment studies.

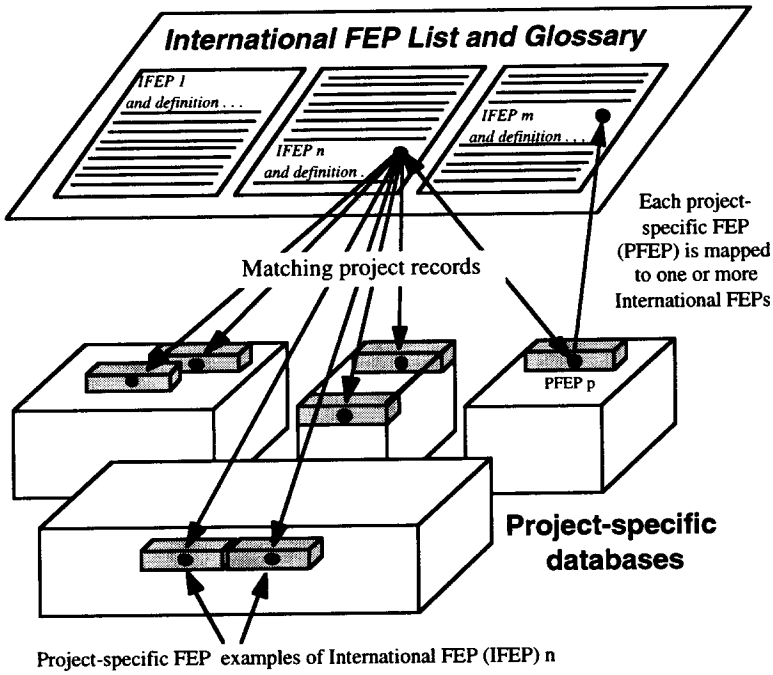
The International FEP List consists of 150 factors and classification scheme by which to examine FEPs from the Project-specific Databases. Each project-specific FEP has been mapped to at least one FEP from the international FEP list.

Version 1.0 of the database includes over 1200 project-specific FEP records from seven projects:

AECL Scenario Analysis for EIS of Canadian Disposal Concept, 1994

About 280 FEPs (termed factors) are included, classified as 1) Vault, 2) Geosphere or 3) Biosphere and ordered alphabetically within each class. Each factor has a description and many have further information on judged importance of the factor in the specific assessment study. About 90 references are included. The list of relevant factors was developed by "brainstorming" meetings amongst AECL project staff. Initially, over 1000 factors were identified and the list reduced by combining closely related factors.

The NEA International FEP Database : Concept

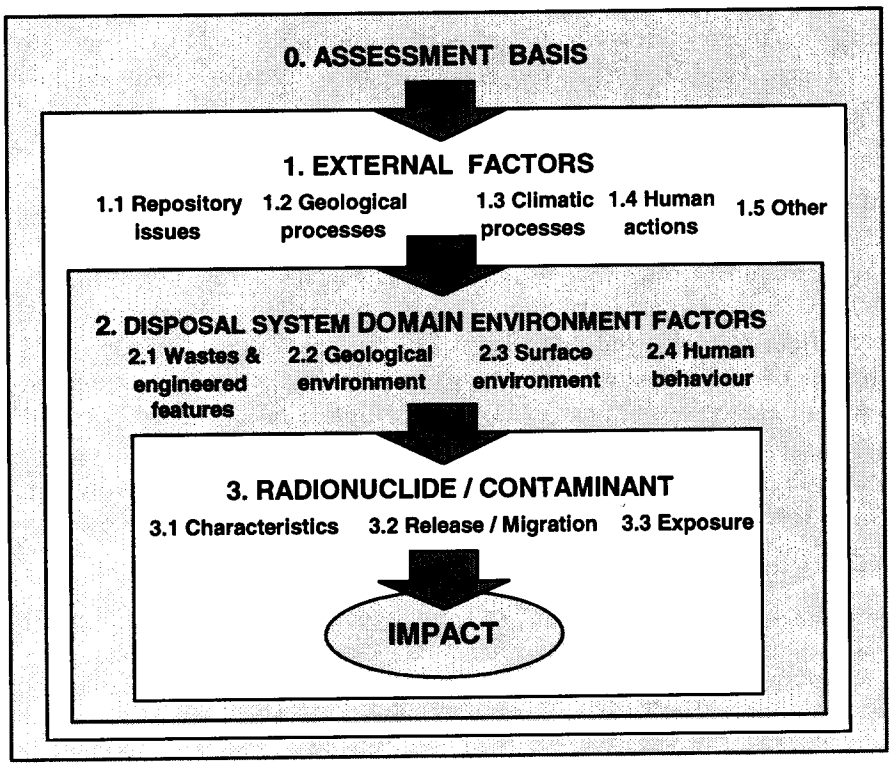


The International FEP List consists of 150 factors, each with a definition and, in many cases, further comments. These are generic, relatively high-level factors and together form a master list and classification scheme by which to examine FEPs from the project-specific databases.

Each project-specific FEP (PFEP) has been mapped to at least one FEP from the international list (IFEP). Thus, most IFEPs have several PFEPs attached, where the attached PFEPs are project-specific examples of the given IFEP.

PFEPs may be examined either through the IFEP list or directly.

The NEA International FEP List : Classification



The International FEP List was derived with the assistance of the hierarchical classification scheme illustrated here. The scheme is based on a environmental system model concept.

It consists of 4 layers, where the 3 inner layers are further divided into categories, each containing of the order of 10 FEPs.

HMIP Assessment of Nirex Proposals – System Concept Group, 1993

About 80 FEPs are included. These are classified as follows: 1) Near field, 2) Geosphere, 3) Climatology, 4) Biosphere, 5) "Short-circuit" pathways. Each FEP is described and also evaluated in the context of the Sellafield site and Nirex repository concept. The list of FEPs and descriptions were developed by a group of eight experts in the relevant topics who had not been previously involved in HMIP assessment modelling studies.

The Joint SKI/SKB Scenario Development Project, 1989

About 160 FEPs are included. FEP classes are not named but examination indicates a scheme as follows: 1) FEPs affecting the waste, 2) FEPs affecting the canister, 3) FEPs affecting the backfill, 4) FEPs affecting the near-field rock, 5) Repository and natural phenomena affecting the far field, 6) Far-field geosphere, 7) Near surface and human actions, (The biosphere was not considered). "Memo comments" are given for each FEP plus project-specific codes indicating the treatment of the FEP. Very few references are included. The list of FEPs and descriptions were developed by four groups of named experts working independently under different systems of classification; the list were then merged.

Nagra Scenario Development for Kristallin-I , 1994

About 240 FEPs are included. These are classified under as follows: 1) Vitrified waste form, 2) Canister, 3) Bentonite, 4) Bentonite-host rock interface, 5) Low-permeability domain crystalline basement, 6) Higher-permeability domain crystalline basement, 7) Major water-conducting faults, 8) Biosphere, 9) Geological processes and events, 10) Climatic processes and events, 11) Human activities. Description are given for each FEP which are extensive in some cases. About 160 references are included. The list of FEPs and descriptions were developed by a contractor based on examination of Nagra reports and in consultation with project staff. The list and descriptions were extensively reviewed by project staff.

NEA Systematic Approaches to Scenario Development, 1992

About 130 FEPs are included. These are classified according to cause: 1) Natural phenomena, 2) Human activities, 3) Waste and repository effects with further division into 13 subcategories. No descriptions or references are included. The list of FEPs was developed by a contractor in the context of a trial of scenario methodology.

SKI SITE-94, Deep Repository Performance Assessment Project

About 100 FEP descriptions linked to the Reference Case PID and the Central Scenario PID are included in the SITE-94 FEP database. The SITE-94 Process System consists of the geosphere and the EBS. The Process System is divided into five main regions: a) Fuel and canister, b) Bentonite buffer, c) Tunnel backfill, d) Near-field rock and e) Far-field rock. The Process Influence Diagram, PID, graphically describes the direct influences between the different FEPs in the Process System. FEPs are introduced in the PID as boxes with a FEP name. Interactions between FEPs are represented on the PID by arrows. The FEP and influence records are electronically linked to the PID. Each FEP record includes a FEP description, its cause and effect and reference to the literature. The nature of the interaction and FEPs coupled are documented in the influence record. In addition, the influence records contain protocols from the development of the Reference Case and the Central Scenario.

US DOE Waste Isolation Pilot Plant, CCA 1996

The WIPP performance assessment reported in the 1996 Compliance Certification Application (CCA) demonstrates compliance against the US Environmental Protection Agency radiation protection standards of 40 CFR Part 191, Subparts B and C. A WIPP-specific comprehensive list of 237 FEPs was compiled for the project. The list was initially based on the SKI compilation

(Stenhouse et al. 1993). Other FEPs relevant or specific to the WIPP were added in review. The list was then restructured into 1) Natural, 2) Waste- and Repository-induced, and 3) Human- induced FEPs. Some FEPs were screened out of performance assessment calculations on consequence (SO-C), low probability (SO-P), and regulatory (SO-R) grounds. The remaining FEPs were included in performance assessment calculations of the undisturbed (UP) and disturbed (DP) performance of the WIPP. Most of the text in the database is taken from Appendix SCR of the CCA, which summarises the screening arguments for each FEP. For further information on each FEP, the user is referred to the pointers to relevant material in the CCA that are given at the bottom of each FEP description.

The NEA International Database of FEPs can be obtained from: *Mr. B. Rüegger [Tel: +33 1 45 24 10 44, Fax +33 1 45 24 11 10, E-mail: ruegger@nea.fr], Radiation Protection and Waste Management Division, OECD Nuclear Energy Agency, Le Seine-Saint-Germain Building, 12, boulevard des Iles, F-92130 Issy-les-Moulineaux].* **A small fee might be required to cover future maintenance and updating costs.**

Thermochemical Data Base (TDB)

The Thermochemical Data Base (TDB) project aims to make available a comprehensive, internally consistent, internationally recognised and quality-assured chemical thermodynamic data base. The work is performed by the NEA Data Bank in close collaboration with the Radioactive Waste Management Committee (RWMC). High priority was assigned to a first series of five elements: Uranium, Americium, Technetium, Neptunium and Plutonium.

The Uranium and Americium volumes have been completed and were published by North-Holland Elsevier Science Publisher in 1992 and 1995, respectively. The Technetium book is ready for publication and should be available at the beginning of 1998. Peer review of the Neptunium/Plutonium draft should start soon.

The OECD has just published "*Modelling in Aquatic Chemistry*" also produced by the project (see list of publications). This publication contains general guidelines on how to use the TDB values and procedures to estimate values in cases where none can be selected based on published experimental work. The different subjects are introduced in an elementary way, including simple examples, thus avoiding the need for prior expert knowledge of the various subjects. The book contains chapters that are intended as guidelines for the chemical equilibrium modelling of aquatic systems, such as ionic strength and temperature corrections. There are also chapters which introduce non-equilibrium modelling, e.g., mass transfer between phases and transport of solutes in aquatic systems.

Specific information on the TDB can be obtained from *Mr. Claes Nordborg, NEA Data Bank, OECD Nuclear Energy Agency, le Seine Saint-Germain, 12 boulevard des Iles, F 92130 Issy-les-Moulineaux, [Tel: +33 (1) 45 24 10 90, Fax: +33 (1) 45 24 11 10, e-mail: nordborg@nea.fr]*

Sorption Modelling Project

A study was started in 1996 to investigate the potential of mechanistic sorption models for improving confidence in performance assessment predictions. The decision to launch this project arouse out of a growing awareness in the radioactive waste management performance assessment community that sorption distribution coefficients (K_d) should be supported by an understanding of the underlying processes.

Participants discussed the desirability of international co-operation to share the important experimental effort that is needed to practically apply chemical modelling to natural systems. The issue is complicated by the fact that national programmes are different and have consequently different needs, different levels of ambition, and are developing different approaches. Participants stressed the need for a cautious and pragmatic approach. They agreed that the objectives of phase I of the project should be:

- To organise an international meeting to gather new information and promote discussions within the scientific and waste management communities;
- To produce, by the end of 1997, a Status Report intended to have a wide dissemination.

Following the above programme, the "*Workshop on Chemical Modelling of Sorption in the field of radioactive waste management*" was organised on 6-8 May 1997, in Oxford, UK. The meeting was organised around four themes:

1. Sorption in the context of performance assessment.
2. The scientific framework of sorption chemical modelling.
3. Practical approaches proposed to model natural systems.
4. State-of-the-art of the use of mass action – mass balance models to describe sorption in natural systems.

The Sorption Modelling Project, and in particular the Oxford meeting, have attracted more interest that anticipated. Most participants were surprised by progress made recently in the field of chemical modelling of sorption in natural systems. Many successful attempts to model sorption of important nuclides onto a variety of natural solid phases have been presented and discussed. The potential of these models has now been clearly demonstrated.

An important work is now necessary to incorporate into a comprehensive and well balanced Status Report the vast amount of information collected so far by the project.

NEA Information Sheets on Sorption Investigations

Sorption experiments are usually extremely costly. It was felt beneficial for managers to be kept informed of such work carried out in other national agencies. This should help them to better manage their own resources, co-ordinating their effort with others, avoiding duplications, etc. For this purpose the NEA Secretariat collects information on on-going or planned sorption experiments in Member countries by means of a single sheet questionnaire. The information is than distributed to PAAG and SEDE members.

Further information can be obtained from: *Mr. Claudio Pescatore on RWMC and PAAG in general, Integrated Performance Assessments WG (IPAG), Validation/Confidence Building (V/CB), [Tel: + 33 1 45 24 10 48, Fax: + 33 1 45 24 11 10, E-mail: pescatore@nea.fr]; from Mr. Bertrand Rüegger on Scenario Analysis and FEPs Data Base, Sorption Modelling Project and Information Sheets on Sorption Investigations, [Tel: +33 1 45 24 10 44, Fax +33 1 45 24 11 10, E mail: ruegger@nea.fr]; both from the Radiation Protection and Waste Management Division, OECD Nuclear Energy Agency, Le Seine-Saint-Germain Building, 12, boulevard des Iles, F-92130 Issy-les-Moulineaux].*

ASARR

As part of its support activities to the Member Countries for the demonstration of the long-term safety of nuclear waste repositories, the NEA is sponsoring the ASARR project, a field study on the mobilisation and migration of uranium in the ground waters surrounding the Koongarra uranium ore

body in the Alligators Rivers region of the Northern Territories of Australia. Participants are the Australian Nuclear Science and Technology Organisation (ANSTO), the Japan Atomic Energy Research Institute (JAERI), the Korea Atomic Energy Research Institute (KAERI) and the United States Nuclear Regulatory Commission (USNRC).

The primary objectives of the studies in the weathered zone of the deposit are to identify and quantify processes which may be significant in the retardation of radionuclides and to refine modelling codes to describe the above processes. The principal aim of the investigations in the unweathered, silicate/oxide zone are to establish the nature and the precursors of the weathering reactions; to model hydrothermal interactions responsible for the alteration halo; and to refine the geologic framework for modelling processes of radionuclide migration in crystalline rock.

Two six-monthly reports covering the year 1996 are available from the project manager or from the NEA Secretariat.

See also sections I.1.5 (Australia) and I.10.3 (Korea). **Further information on the ASARR Project can be obtained from**: *Mr. Peter L. Airey, Environment Division, Building 64, ANSTO, Private Mail Bag 1, Menai, NSW 2234, Australia [Tel: +61 (2) 9717 3272, e-mail: pla@ansto.gov.au, Fax: +61 (2) 9717 9293; or from Mr. C. Pescatore, Radiation Protection and Waste Management Division, OECD Nuclear Energy Agency, Le Seine Saint-Germain, 12, boulevard des Iles, 92130 Issy-les-Moulineaux, France, [Tel: +33 (1) 45 24 10 48, e-mail: pescatore@nea.fr, Fax: +33 (1) 45 24 11 10].*

II .3.1.3 SEDE Co-ordinating Group

Introduction

The Co-ordinating Group on Site Evaluation and Design of Experiments for Radioactive Waste Disposal (SEDE) is an international forum on methodologies and strategies for characterising and evaluating disposal sites. Since 1991, this Group has been fostering common, in-depth scientific and technical understanding with respect to important site characterisation and evaluation issues and has been contributing to building confidence in the appropriateness of geoscientific methodologies used at national level. It promotes a constant evaluation/understanding of the existing commonalties and differences between the programmes, and also facilitates the creation of a network of identified national experts among national waste management organisations, regulatory bodies and the scientific community.

The SEDE Group held its seventh annual meeting in Paris, France, on 21-23 October 1996. The first Joint PAAG/SEDE Topical Session on *"The Geosphere in Integrated Performance Assessment"* was an integral part of the meeting (see below).

SEDE Programme of Work

As most national programmes are shifting from a research phase to a development and demonstration phase for potentially suitable sites, the need has arisen to foster co-operation between site characterisation and safety-analysis specialists on the basis of site-specific geoscientific information, to integrate design and construction issues, and to look at the interfaces between the various components of the repository system.

These needs are partly reflected in the current SEDE programme of work, which focuses on four areas whose objectives are:

1. *Underground Testing*: build confidence in the in situ characterisation methodologies;
2. Role of the Geosphere in Safety Assessment: confidence building in the geosphere as a barrier;
3. *Interface between the Geosphere and the Engineered Barrier System*: assessment of the perturbation induced in the geosphere by the repository; and
4. *Argillaceous Media ("Clay Club"):* build confidence in the hydrogeological characterisation of argillaceous media.

The SEDE activities are, consequently, more and more closely linked with those of the PAAG. There is indeed a variety of topics that both SEDE and PAAG have identified and that they should address from their respective perspectives in order to gain understanding and build confidence in the geosphere barrier. The launching of the GEOTRAP project and the holding of a first Joint Topical Session on *"The Geosphere in Integrated Performance Assessment"* exemplify this trend.

SEDE Recent Achievements and Initiatives

A. Role Of The Geosphere Barrier In Safety Assessments

To exemplify the above mentioned trend, two of the main SEDE activities in the area of the assessment of the role of the geosphere as a barrier were carried out in close co-operation with the PAAG, and are considered specifically in item II.3.1.4.:

- the launching of the GEOTRAP project on radionuclide migration in actual geologic formations; and
- the holding of a first Joint Topical Session on *"The Geosphere in Integrated Performance Assessment"*.

One of the next specific SEDE initiative in this area relates to the matching of the results of the various methodologies used to characterise a site. Groundwater chemistry together with other information may provide a multidisciplinary method to test site-specific flow models, especially with long-term periods involved. Therefore, a workshop on the *"Use of Hydrogeochemical Information in Testing the Models for Groundwater Flow"* will be organised by SEDE in the Autumn 1997.

B. "The Interfaces between the Geosphere and the Engineered Barrier System"

Efforts to understand the potential impact of gas migration, and of other two-phase processes, on the performance of underground repositories, and to provide modelling tools or approaches that will allow these impacts to be assessed, have resulted in an important amount of documentation, most of it being rock-, concept-, and waste-specific. Therefore, the SEDE will help prepare, jointly with the EC-DGXII, a Status Report on the understanding of gas migration and two-phase gas-water flow processes and their potential impacts on the performance of the geosphere as a barrier. The report will take into account all the geologic media currently considered as potential host rock. It will also help avoid duplication in future work, promote shared experience in, and establish requirements for the design of experiments, and provide a focus for the identification and prioritisation of research needed on unresolved issues. The project proposal, submitted to the EC as a Concerted Action, is at an advanced stage of processing/approval within the EC.

C. "Argillaceous Media" (the "Clay Club")

The SEDE Working Group on *"Measurement and Physical Understanding of Groundwater Flow Through Argillaceous Media"* (informally named the "Clay Club") serves as a forum for exchanging detailed information and results on in situ characterisation activities. It also promotes a constant intercomparison of the characteristics of argillaceous rocks studied with respect to radioactive

waste disposal, and an assessment of the state-of-the-art of the current understanding of the processes that control water, gas and solute movement in clays.

Second "Clay Club" Workshop

The second workshop of the "Clay Club" was hosted by Nagra in Berne (Switzerland) on 10-12 June 1996, and was co-organised by NEA and the EC-DGXII. It dealt with *"Fluid Flow through Faults and Fractures in Argillaceous Formations"*, and was aimed at discussing basic concepts and processes of fracture flow, evidence of flow and no-flow, characterisation methodologies, and relevance of fracture flow for repository safety and performance. It also allowed an exchange of information with the oil industry and the scientific community at large. Fracture flow in argillaceous media cannot be excluded per se and may appear under certain conditions (e.g. overpressurisation at great depth). There are however strong mechanical and chemical reasons for faults to be tight at repository depth (very good examples of real tightness and perfect fault-sealing were presented).

In the framework of the workshop, a technical visit to the Mt. Terri underground research facility was organised. This project is an international underground research project in a reconnaissance highway tunnel (Folded Jura mountains, NW Switzerland) in the Opalinus Clay (Mesozoic shale), for which the "Clay Club" served as an informal launching platform.

The workshop proceedings, which will include an executive summary, are being prepared by the Secretariat.

Sixth and Seventh Meetings

The sixth and seventh meetings of the "Clay Club" were hosted by Nagra in Berne (Switzerland) on 13-14 June 1996 and by IPSN in Millau (France) on 21-23 May 1997 respectively. On 22 May 1997, IPSN led a technical visit of the Tournemire Underground Research Facility. Some of the initiatives that were launched at these two meetings are summarised below.

A permanent issue of concern for the characterisation of low-permeability media is the collection of representative pore water samples for chemical and isotopic analysis. Therefore, it was proposed that the "Clay Club" commissions the preparation of a critical review report on the current methods of extraction of water and solutes from argillaceous rocks, the available interpretation techniques, and the representativeness of water samples obtained.

In order to help provide a sound basis to further performance assessment exercises, a catalogue of Features, Events and Processes relevant to the performance of argillaceous media as geologic barrier will be compiled. The focus will be on the processes which might play a role in the behaviour of argillaceous media with respect to water, gas and solute movement. The proposed catalogue is primarily aimed at providing for each process:

- an up-to-date overview of conclusions and key references related to its relevance for safety and construction;
- information on on-going and planned work; and
- an assessment of the ways it has been addressed and incorporated into current site evaluation and/or performance assessment exercises.

The catalogue will cover the whole spectrum of argillaceous media under consideration as host rocks.

Further information on the SEDE and "Clay Club" activities can be obtained from: *Mr. Philippe Lalieux, Radiation Protection and Waste Management Division, OECD Nuclear Energy Agency, Le Seine-Saint-Germain Building, 12, boulevard des Iles, F-92130 Issy-les-Moulineaux [Tel: + 33 1 45 24 10 47, Fax: + 33 1 45 24 11 10, E-mail: lalieux@nea.fr].*

II .3.1.4 Joint PAAG/SEDE Activities

PAAG/SEDE Topical Session

In order to strengthen the links between site characterisation activities and performance assessment exercises, a Joint PAAG/SEDE **Topical Session** was organised in connection with the meetings of both groups in the fall of 1996. On that occasion, the two groups discussed the results of the analysis of the Integrated Performance Assessment Group (IPAG), with special emphasis on the treatment of the geosphere in performance assessment, the role of the geosphere in safety and the interaction between performance assessment and site characterisation. Based on this session, a series of specific topics to be addressed later on by the SEDE were identified:

- Integration/interaction of site characterisation, performance assessment and design/operation;
- Role of hard vs. soft data and impact on site characterisation;
- Practical experience in building an integrated team;
- Stepwise approach (confidence level, indicators, multiple lines of reasoning);
- "Truth" about the multi-barrier/redundancy concept; and
- Treatment of variability and uncertainty (in the presence of conservatism).

GEOTRAP Project

The joint PAAG/SEDE **GEOTRAP** Project on *Radionuclide Migration in Geologic, Heterogeneous Media* aimed at building confidence in the modelling of transport in actual geologic formations has held two workshops.

The first workshop was devoted to *"Field Tracer Transport Experiments: Design, Modelling, Interpretation, and Role in the Prediction of Radionuclide Migration"*, was organised jointly with the EC-DGXII, and hosted by GRS in Cologne (Germany) on 28-30 August 1996. This workshop facilitated discussion of the rationale and objectives of tracer tests, provided an overview of on-going in situ studies of radionuclide migration phenomena and relevant properties of geologic media, and allowed assessment of the reliability and usefulness of these tests for the prediction of radionuclide transport.

The second workshop in the GEOTRAP Project was devoted to the *"Basis for Modelling the Effects of Spatial Variability on Radionuclide Migration"* and hosted by ANDRA in Paris (France) on 9-11 June 1997. Within the context of geosphere conceptualisation and performance assessment, the workshop discussed the importance of heterogeneity at different spatial scales and its impact on the quantification of radionuclide migration. In particular, the geological basis for the description of spatial variability, the various approaches in the conceptual representation of spatial variability and in its quantification were addressed as future areas for investigation and the feedback on further site characterisation and performance assessment activities.

The proceedings, which will include a synthesis report, of these two workshops are being prepared by the Secretariat. On the basis of these two workshops, the GEOTRAP project should meet its objectives and help bridge the gap between geoscientific data acquired in the field and their uses for performance assessment purposes.

Further information on the GEOTRAP Project can be obtained from: *Mr. Claudio Pescatore [Tel: + 33 1 45 24 10 48, Fax: + 33 1 45 24 11 10, E-mail: pescatore@nea.fr], and Philippe Lalieux, [Tel: + 33 1 45 24 10 47, Fax: + 33 1 45 24 11 10,*

E-mail: lalieux@nea.fr], both from the Radiation Protection and Waste Management Division, OECD Nuclear Energy Agency, Le Seine-Saint-Germain Building, 12, boulevard des Iles, F-92130 Issy-les-Moulineaux.

II .3.1.5 The Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installations Decommissioning Projects

Introduction and Programme Organisation

In response to the growing interest in the decommissioning of nuclear facilities, the Nuclear Energy Agency of the OECD launched in 1978 a programme of activities in this field. The work of the NEA was initially limited to the organisation of international meetings of experts and the preparation of surveys and state of the art reports. Subsequently, however, the Agency set up, in 1985, the International Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects. This concept of working together among a number of decommissioning projects exchanging information, experience and possibly personnel, and carrying out other forms of co-operation as appropriate, obtained strong support from all OECD countries having one or more important decommissioning projects either underway or in the planning process.

The programme was formally initiated in September 1985 for a first five-year term, and was subsequently extended for a second five-year term in view of its successful performance. As this success has continued with now an even broader range of participating countries and projects, the agreement has been extended for a third five-year period.

The first five years of this programme represented a watershed in the evolution of decommissioning as a mature technical discipline. In its own right, each of the participating projects made a significant contribution not only towards developing various decommissioning technologies, but also in demonstrating them in the field. For the second five-year period the primary objective has been to contribute to the industrialisation of decommissioning by facilitating the exchange of information and of related experience between participating projects. This objective can be said to have been met, as evidenced by the continuing increase in participating organisations.

In order to assure the appropriate management and organisation of the Co-operative Programme, the Liaison Committee (LC), made up of project-management-level representatives of each project in the Programme, oversees the Programme's operations and administration, and sets Programme priorities, goals and objectives. The Technical Advisory Group (TAG), made up of technical representatives from the participating projects, reports to the LC and performs in-depth, technical studies assigned by the LC or proposed by the TAG and approved by the LC. Four such technical studies are currently underway.

One of the objectives of the Programme has always been the dissemination of information, including the publication of authoritative reports on various decommissioning subjects. A full list of the Programme's publications can be found at the end of this article. One of the Programme's latest publications is a report summarising the last five-years of experience. Material from this article is taken mainly from that report, titled, "*The NEA Co-operative Programme on Decommissioning: The First 10 years, 1985 - 95*".

Programme Description and Participation

Currently, 35 projects from 12 countries participate in the Programme, including projects from two non-NEA Member countries (Slovak Republic and Estonia). These include decommissioning of 25 reactors, 7 reprocessing plants, 2 fuel material plants, and 1 isotope handling facility. As a result of the wide variation in the type of facility being decommissioned, and in the environment under which the activity is to be undertaken, and to assist in the comparison of information and experience, the focus of the Programme has been in seven broad areas:

- assessment of activity inventories,
- cutting techniques,
- remote operation,
- decontamination,
- melting,
- radioactive waste management, and
- health and safety.

The study of these areas has led to a greater depth of knowledge, and in some areas the ability to compare results found on various projects. For example, the assessment of radioactive inventories is seen as the essential first step in defining the requirements of a decommissioning project. Indeed, radioactive inventories are needed for decommissioning planning, waste categorisation, waste transportation and safety assessments. In addition, licensing authorities frequently require information on the radioactive waste inventory. Where measurements have been made, it has been possible to verify calculations against measured inventories with reasonable agreement.

In the various participating projects, a wide range of cutting techniques have been demonstrated and employed on both metals and concrete. For metal cutting, a comparison has been made between the various methods available, and it has been demonstrated, that in some situations, the use of mechanical cutting techniques offers significant advantages in terms of volume of secondary waste produced. The use of diamond saw cutting for pre-stressed concrete has been shown to be a practical method that can be employed to advantage. Other techniques under consideration include the cutting of both metal and concrete without either a lubricant or coolant, using methods such as steel and tungsten carbide discs, milling and dry milling saws. From the studies to date, the use of metal discs has proved successful. But, as it was concluded in the first five-year report, there is no ideal cutting method and it is necessary to select the appropriate technique for the material to be cut together with the environment in which it is to be used.

Whilst the use of robotics or autonomous machines only had limited use in the participating projects during the last five-year period, confidence is being gained to enable wider use in the future. These systems are comparatively expensive, but sometimes offer the only practical solution to the dismantling of highly active plant components, or to working in extremely high dose-rate areas. However, even in lower dose-rate areas there may also be advantages in the use of robotics in reducing the work force exposure in situations where traditional hands on working would normally be considered.

The area of decontamination techniques is considered to be fundamental to decommissioning activities, and a special TAG working group on this subject has been formed to develop a detailed report of current, state-of-the-art techniques. A wide range of decontamination techniques have been employed in the various projects. One major demonstration has been the successful use of the "shaving" technique, using a diamond tipped cutting head for the decontamination of concrete. This has been shown to be over three times as fast as the more usual scabbling method and in addition produced only half the volume of secondary waste.

There are five plants currently melting contaminated metals on an industrial scale. The objective of melting is to allow the recycling of metals from the decommissioning process which are slightly contaminated.. The melting process provides for some decontamination of the metals, with some contaminants, generally in the form of oxides, separating from the metal during the melting process. For example, non-ferrous metals from this melting process can be freely released in many cases. In some cases, however, metals still contain contamination levels higher than regulatory clearance criteria, and must remain under regulatory control. These can be used for construction within the nuclear industry for example. Some steel products contaminated with cobalt-60 fall into this category. Only a brief overview of new developments in this area has been given, but it can be seen that a new industry for minimising the quantity of active metallic waste is being established. This also convincingly demonstrates that significant quantities of metal can either be released for unrestricted use or released for reuse in the nuclear industry. Another TAG working group was established to study the question of clearance levels for metals from the decommissioning process, and a report has been published to add the views of decommissioning implementors to the ongoing international debate on this subject.

As can be expected from the range of projects participating in the Programme, a diverse range of wastes must be managed. This has led to a wide variety of methods for dealing with wastes. Often, however, the most important factors to be considered and satisfied are national regulatory requirements.

In terms of occupational exposure, the actual radiation doses received by the work force are in general lower than those calculated when assessing the work. Of particular interest is the work carried out to improve the physical comfort when working in a ventilated suit. A system has been developed that provides both breathing and cooling air. Included are breath activated devices to increase air supply, special air to refresh the operator's face and removal of condensation.

Decommissioning Costs

One of the in-depth studies performed by the TAG concerns the cost of decommissioning. Initially, cost data from 12 projects was used to establish a basis for the comparison of costs. From this comparison it has been possible to gain a better understanding of the costs in decommissioning projects, although the analysis technique employed cannot be used to predict decommissioning costs for a particular project.

An important observation made during this study was that a standardised listing of cost items or estimating methodology does not exist for decommissioning projects. Such standardisation would not only make cost comparisons possible, but would in addition provide a sound tool for project cost management. Based on this observation, the NEA has built a joint project with the EC and the IAEA to establish a standard list of cost groups, and within these groups cost items with relatively precise definitions. Using this structure, costs of any decommissioning project in any country can be meaningfully compared. It is hoped that this work will be completed early in 1998 and published as a joint NEA, EC, IAEA report. Based on this work by the TAG working group, a number of projects within the Programme have remodelled their cost management structure.

Decontamination

As previously mentioned, a study of the state-of-the-art decontamination techniques to be used in connection with decommissioning has been undertaken. Decontamination is frequently required in a decommissioning project in order to:

- reduce radiation exposure to the operating staff;

- salvage equipment and materials for possible reuse;
- reduce the volume of equipment and materials requiring disposal in licensed burial facilities;
- restore the site and facility, or parts thereof, to an unrestricted use condition;
- remove loose radioactive contaminants and fix the remaining contamination in place, in preparation for protective storage or permanent disposal work activities; and
- reduce the magnitude of the residual radioactive source in a protective storage mode for public health and safety reasons or reduce the protective storage period.

A number of physical, electro-chemical and chemical processes have been identified that are relevant to decommissioning and the characteristics of each method have been considered. The studies are continuing to enable guidelines to be produced for the selection for any particular application, and a final report by the TAG working group performing this work is expected in 1997.

Recycling and Reuse

As mentioned above, the recycling of materials from decommissioning activities is an effective way to optimise the use of valuable resources, and can also be very cost effective. A Tag working group was established to examine the means for maximising the recovery of valuable materials arising from decommissioning operations, while at the same time minimising wastes for disposal. The study has been completed with regard to metallic wastes and is to be continued looking at non-metallic wastes.

The key to this study has been the cost-benefit analysis used to determine regulatory clearance levels, that is, those regulatory levels of contamination below which materials can be released for uncontrolled use. The TAG working group focused on this cost-benefit analysis, using an integrated risk management approach to take into account not only the costs associated with the radiological risks associated with material containing contamination levels above natural background, but also the risks associated with replacing, as opposed to recycling, such materials (mining, milling, transportation, etc.). In addition, the working group suggested the concept of the tiered release of metals. Some very metals would always require regulatory control, some slightly contaminated metals could be released to a regulated smelting facility where these could be mixed and diluted, resulting in metals below the release criteria, and some metals below regulatory clearance levels could be released outright for immediate reuse.

Currently, there are no internationally accepted standards for the clearance of contaminated materials, although documents from the IAEA and the EC have proposed clearance levels based on radiation-risk considerations alone. A report summarising the findings of the TAG working group was recently published by the NEA, titled, "*Nuclear Decommissioning: Recycling and Reuse of Scrap Metals*". It is hoped that this document will contribute new and interesting ideas to the ongoing international debate in this area.

Conclusion

As the world's fleet of nuclear reactors ages, increasing numbers of these plants will begin decommissioning operations. In order to perform this work in the most efficient manner, in terms of worker safety, waste generation, desired end results, and cost effectiveness, the experience gained today must be effectively shared. For the past ten years the NEA's Co-operative Programme in Decommissioning has served as a very useful forum for the exchange of information in this very important area. For the next five-year period the exchange of information and experience will continue, and additional emphasis will be put on ensuring promulgation of this valuable information

and experience to a wider audience than the participating projects. It is also hoped that the continuing work of the Programme, with its vast practical experience, will be useful in the development of national and international standards and regulations in the area of decommissioning.

Further information on the NEA's Co-operative Programme on Decommissioning can be obtained from: *Mr. Edward Lazo, Radiation Protection and Waste Management Division, OECD Nuclear Energy Agency, Le Seine Saint-Germain, 12 boulevard des Iles, F 92130 Issy-les-Moulineaux, [Tel: +33 (1) 45 24 10 45, Fax: +33 (1) 45 24 11 10, E-mail: lazo@nea.fr].*

II .3.2 Past NEA Workshops on Radioactive Waste Management

GEOTRAP Workshops

- *Field Tracer Transport Experiments: Design, Modelling, Interpretation, and Role in the Prediction of Radionuclide Migration* (NEA/EC), Cologne (Germany), 28-30 August 1996
- *Basis for Modelling the Effects of Spatial Variability on Radionuclide Migration,* Paris (France), 9-11 June 1997; (see above, GEOTRAP Project).

"Clay Club" Workshop

- *Fluid Flow through Faults and Fractures in Argillaceous Formations* (NEA/EC), Berne (Switzerland), 10-12 June 1996; (see above, Argillaceous Media, the Clay Club).

Sorption Workshop

- *Chemical Modelling of Sorption in the field of radioactive waste management,* Oxford (UK), 6-8 May 1997; (see above, Sorption Modelling Project).

II .3.3 Upcoming or Very Recent Meetings/Conferences

NEA official or sponsored meetings:

- 1-3 September 1997, SEDE Workshop on the Use of Hydrogeochemical Information in Testing the Models for Groundwater Flow, Borgholm, Sweden.
- 4-5 September 1997, 8th Meeting of the NEA Co-ordinating Group on Site Evaluation and Design of Experiments for Radioactive Waste Disposal (SEDE), Borgholm, Sweden.
- 24-26 September 1997, 13th Meeting of the NEA Performance Assessment Advisory Group (PAAG), Paris, France.
- 25 September 1997, PAAG Topical Session on Regulatory Developments, Paris, France
- 12-13 March 1998, Radioactive Waste Management Committee, Paris, France.

Other meetings:

- 8-11 September 1997, ICRP Committee 4, Oxford, UK.
- 28 September-3 October 1997, 21st International Conference on the Scientific Basis for Nuclear Waste Management, Davos, Switzerland.

- 12-16 October 1997, 6th International Conference on Radioactive Waste Management and Environmental Remediation, Singapore.
- 26-31 October 1997, 6th International Conference on the Chemistry and Migration Behaviour of Actinides and Fission Products in the Geosphere, MIGRATION'97, Sendai, Japan.
- 1-5 March 1998, Waste Management '98, Tucson, Arizona, USA.
- 11-15 May 1998, International High-level Radioactive Waste Management Conference, Las Vegas, Nevada, USA.
- 31 August-4 September 1998, Health and Environmental Criteria and Standards, Stockholm, Sweden.
- 13-18 September 1998, PSAM 4, Probabilistic Safety Assessment and Management, New York City, USA.

II .3.4 Recent OECD/NEA Waste Management Publications

Publications Récentes de l'AEN/OCDE dans le Domaine de la Gestion des Déchets Radioactifs

- **Modelling in Aquatic Chemistry,** by I. Grenthe and I. Puigdomenech, Royal Institute of Technology, Stockholm, Sweden. Contributors: B. Allard, J. H. Ephraim, Linköping University, Linköping, Sweden, S. A. Banwart, University of Bradford, Bradford, United Kingdom, J. Bruno, QuantiSci SL, Cerdanyola, Spain, R. Grauer, J. Hadermann, W. Hummel, A. Jakob, T. Karapiperis, Paul Scherrer Institute, Villigen, Switzerland, I. Grenthe, A. V. Plyasunov, I. Puigdomenech, Royal Institute of Technology, Stockholm, Sweden, J. A. Rard, Lawrence Livermore National Laboratory, Livermore, California, USA, S. Saxena, University of Uppsala, Uppsala, Sweden, and K. Spahiu, Swedish Nuclear Fuel and Waste Management Co. (SKB), Stockholm, Sweden. Secretariat: M. C. A. Sandino and I. Puigdomenech, OECD/NEA Data Bank, France. OECD/NEA, Paris, 1997.

  This publication contains guidelines on how to use the NEA-recommended TDB values, and on procedures to estimate values for cases where none can be recommended based on published experimental work.

  This volume is of interest to any person involved in modelling of aqueous systems, including scientists working in non-nuclear activities. Each subject is introduced in an elementary way, including simple examples, and prior expert knowledge in the various subjects is not required.

  The text contains the scientific background, and references, to the various subject areas, and is therefore a reference source also for the experts working with modelling of aquatic systems. Emphasis is given on the advantages and limitations of the various models described in the frame of a simplified systems discussion. Some of the chapters are intended as guidelines for the chemical equilibrium modelling of aquatic systems (for example, ionic strength and temperature corrections). Other chapters are intended to introduce the reader to non-equilibrium modelling: mass transfer between phases and transport of solutes in aquatic systems.

  Each chapter has been written independently by the author(s), while the co-ordination of the different subjects has been the task of the editors. A peer-review procedure has been followed to ensure the quality of the text.

- **The International Intraval Project, Phase 2,** Working Group 1 Report, Flow and Tracer Experiments in Unsaturated Tuff & Soil, Las Cruces Trench & Apache Leap Tuff Studies, OECD/NEA, Paris 1997.
- **The International Intraval Project, Phase 2,** Working Group 2 Report, Finnsjön, Stripa and WIPP 2, OECD/NEA, Paris 1996.
- **The International Intraval Project, Phase 2,** Working Group 4 Report, The analyses of the Alligator Rivers Natural Analogue, OECD/NEA, Paris 1996.
- **The International Intraval Project, Phase 2,** Summary, OECD/NEA, Paris, in preparation.
- **Management of Separated Plutonium : The Technical Options,** OECD/NEA, Paris 1997.

  Stocks of separated plutonium in the civil nuclear fuel cycle are currently increasing. The technologies available to handle, use and dispose of it are of considerable current interest. This report presents a consensus view of experts on current and possible future technologies, based on over two decades of industrial experience of using plutonium.
- **La Gestion du plutonium séparé : Les options techniques,** OCDE/AEN, Paris 1997.

  Les stocks de plutonium séparé en provenance du cycle du combustible nucléaire civil s'accroissent. Les techniques employées pour mettre en œuvre, utiliser et évacuer ce plutonium offrent aujourd'hui un intérêt considérable. Ce rapport présente une analyse effectuée par un groupe d'experts sur les technologies actuellement disponibles et sur celles qui pourraient le devenir prochainement, en prenant en compte plus de vingt ans d'expérience de gestion du plutonium dans l'industrie.
- **Regulating the Long-Term Safety of Radioactive Waste Disposal,** Proceedings of an NEA Workshop, Cordoba, Spain, 20-23 January 1997, OECD/NEA, Paris, in preparation.
- **Field Tracer Transport Experiments: Design, Modelling, Interpretation, and Role in the Prediction of Radionuclide Migration,** Proceedings of the 1st NEA/EC GEOTRAP Workshop, Cologne, Germany, 28-30 August 1996, OECD/NEA, Paris, in preparation.
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- **Fluid Flow Through Faults and Fractures in Argillaceous Formations,** Proceedings of a Joint NEA/EC "Clay Club" Workshop, Bern, Switzerland, 10-12 June 1996, OECD/NEA, Paris, in press.
- **Review of Integrated Performance Assessments of Deep Geological Repositories for Long-Lived Nuclear Wastes,** IPAG - Phase-1, Report of an NEA Working Group, in preparation.
- **Safety Assessments of Radioactive Waste Repositories: An International Database of Features, Events and Processes,** Report of an NEA Working Group with database, in preparation.

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The new Head of Division is not known at the time of editing the present issue of the Nuclear Waste Bulletin. Mr. Claudio Pescatore is presently Acting Head.

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