A report by the Uranium Institute Waste Management & Decommissioning Working Group

WORLDWIDE ADVANCES IN RADIOACTIVE WASTE MANAGEMENT

July 1999 - July 2000

This report was produced by the Uranium Institute's Waste Management and Decommissioning Working Group. It presents a world-wide review of significant progress made in radioactive waste management from July 1999 to July 2000.

In writing this report, the working group has considered all categories of radioactive wastes, from the whole nuclear fuel cycle. The levels of progress that are considered here include international and national decisions, commercial commissions, as well as scientific and technological advancements.

The working group has produced other documents in this area which are available from the Uranium Institute, or can be accessed on the World Wide Web (http://www.uilondon.org).

July 2000

The Waste Management and Decommissioning Working Group:

Mr Xavier Rincel	**COGEMA**	**Chairman**
Ms Sylvie Aubry	EDF	
Mr Herbert Bay	NOK (KKG)	
Mr Jochem Becker	Uranerz	
Mr Pierre Debiève	Belgonucléaire	
Mr Guy Demazy	Synatom	
Mr Ian Duncan	Consultant	
Mr Stan Frost	Cameco	
Dr Wolfgang Kersting	GKN	
Mr Veijo Ryhaenen	Posiva	
Mr Jeff Smith	Foratom	
Mr David Warner	BNFL	
Ms Marika Westman	SKB	
Mr Maurice Lenders	Urenco Ltd	(Executive Committee Mentor)
Ms Emma Cornish	Uranium Institute	(Secretary)

Published by the Uranium Institute,
Bowater House West, 114 Knightsbridge, London SW1X 7LJ, UK.
Tel: (+44) 20 7225 0303, Fax: (+44) 20 7225 0308
Email: ui@uilondon.org
Website: www.uilondon.org

Table of contents

Summary

This, the second report from the Uranium Institute Waste Management and Decommissioning Working Group, publishes the main achievements and developments in the field over the last year. It does not consider all the advances in that time, but instead identifies what the members of the working group consider to be the main points of progress towards the long-term safe disposal of all levels of radioactive waste.

Certainly, the long-term disposal of high-level waste (HLW) remains the most politically charged issue to be resolved. But many milestones have been accomplished with the establishment of research facilities for HLW repositories in Belgium, France, Germany, Canada, Sweden and Switzerland. Scientific research continues with the Yucca Mountain repository in Nevada, US, though the project has been delayed yet again at the political level with Clinton's recent veto of the waste bill. The prospects for a HLW repository in Finland look promising: the government is expected to confirm that Eurojoki will be appointed the site for the spent-fuel repository and construction should begin by 2010. Meanwhile, Japan has successfully passed its nuclear waste bill, to provide a framework for the final disposal of HLW, to the Upper House.

Two major international organisations, the IAEA and the OECD/NEA, have brought the question of public consensus-building to the fore recognising that HLW management issues have a marked impact on public opinion of the nuclear industry. Increasingly countries with nuclear generating programmes are involving all stakeholders at the decision making level for the development of national repositories or even for waste management strategies. Switzerland invited all stakeholder groups to comment on its revised atomic law, which included questions on the necessity of providing a full public consultation prior to the initiation of a radioactive waste disposal programme.

Whilst HLW disposal facilities are lacking, governments and the industry work to increase interim storage facilities for spent fuel. Private Fuel Storage (PFS), a consortium of eight US utilities' received acceptance from the US NRC for their proposal to build a spent fuel storage facility in Utah. This is considered an interim measure until such a time that the fuel can be transferred to the Yucca Mountain repository. Elsewhere, utilities have been expanding on-site storage facilities. Activity is particularly apparent in Germany since the government's decision to phase out nuclear power over the course of the next 25 years and to delay exploration work on the Gorleben salt dome for some three to ten years.

Intermediate and low-level wastes account for about 90% of wastes from the nuclear industry and some facilities accept radioactive wastes from other sectors such as the medical industry. Oil production, rarely associated with radioactive waste, is the source of a new industry partnership with the UK's nuclear industry assisting in the disposal of three drums of low specific activity waste from the Brent Spar decommissioned oil platform. The waste will be conditioned and sent for disposal at BNFL's Drigg site.

It is reassuring to witness the oil industry, also a mature industry, take advantage of nuclear waste management experts' wealth of technical knowledge. The nuclear industry takes pride in its commitment to safely containing, storing and ultimately disposing of its wastes without adverse impact on the environment or society. In many parts of the world it is true that political and public support for HLW repositories is lacking. In Finland however, which looks to be the first country to start construction of an underground repository for high-level waste, 78% of the population from the Eurajoki municipality support the proposal - proof that the disposal of HLW is surmountable.

1. International reports, policies & decisions

1.1 *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. The Convention has 41 signatories and 22 Contracting States. 34 signatories to the Convention met from 18 - 21 October 1999 to prepare a review process required under the treaty. The review process requests Parties to issue formal reports on the status of their national waste management practices. *For the status of the Convention go to* http://www.iaea.org/worldatom/updates/convention.html

1.2 Geological disposal remains the only truly available option for ensuring safe waste disposal, according to an OECD/NEA report, *Geological disposal of radioactive waste: review of developments in the last decade*, released late October 1999. The experts acknowledge that achieving public consensus towards radioactive waste management strategies poses the greatest barrier to improving public attitudes towards nuclear energy.

1.3 At a conference in November 1999, the IAEA Director-General, Mohamed ElBaradei called for immediate action towards the permanent disposal of high-level radioactive waste. He commented on the collective opinion of experts, that geological disposal can be realised and its safety assessed by methods that are already available. Public acceptance remains the greatest barrier.

1.4 The International Commission on Radiological Protection (IRCP), Publication 77, *Radiological Protection Policy for the Disposal of Radioactive Waste, Annals of the ICRP Vol. 27 Supplement*, reaffirms the Commission's current policy of radiological protection, in particular its policy on public exposure, and aims to clarify the practical application of that policy to the disposal of radioactive waste. It discusses the justification of a practice, the optimisation of protection, the use of collective dose assessed over long distances and times, the implications of potential exposure, and the distinction between practices and intervention. In particular, it explains why collective doses should not be ignored simply because the individual doses contributing to them are small. However, it also stresses that collective doses may need to be presented separated into blocks of limited ranges of dose and time, and forecasts of collective dose over long time periods should include a critical examination of their uncertainty. This report is expected to be important to anyone dealing with radiation protection policy, obviously in the context of waste disposal, but also in general because of the explanations of the Commission's policy concerning collective dose.

1.5 The International Atomic Energy Agency (IAEA) reviewed the plans for a high level waste repository submitted by the Swedish Nuclear Fuel and Waste Management Company, SKB. The Swedish concept, which proposes the use of copper-steel canisters buried 500 m deep in the Swedish bedrock, was judged sound. The IAEA team did, however, consider it necessary to recommend more frequent safety reviews to update scientific and technical information. In addition, the Agency requested SKB to initiate discussions with the Swedish safety authorities, SSI and SKI, on their future requirements for risk assessment and safety analysis.

1.6 The International Commission on Radiological Protection (ICRP), Publication 81, *Radiation Protection Recommendations as Applied to the Disposal of Long-lived Solid Radioactive Waste, Annals of the ICRP Vol. 28*. This publication makes recommendations to apply to new disposal facilities. The present publication deals with the radiological protection of members of the public following the disposal of long-lived solid radioactive waste using the ‘concentrate and retain’ principle. The main protection issue concerns a potential exposure situation.

2. Governmental reports, policies & decisions

2.1 General policies, plans & funding

2.1.1 Czech Republic: In January 2000, the three Czech repositories were transferred to state ownership ahead of the summer deadline that had been stipulated in the new atomic law. The three sites are: the Dukovany surface repository for low-level radioactive waste; the Bratrstvi mine complex; Jachymov near Litomerice, for LLW and ILW. The new atomic law also led to the established of the radioactive waste repository authority (RAWRA).

2.1.2 France: In March, OPECST, the parliamentary commission for the assessment of scientific and technological options, fully endorsed the recommendations from MP Michèle Rivasi's report entitled *The consequences of nuclear waste storage facilities for human health and the environment.* The report recommends twelve different measures including:

- Increasing research and development in order to reduce radioactive discharges, ahead of the 2020 OSPAR deadline, to levels close to zero for artificial radionuclides and near to background levels for naturally occurring radionuclides.
- Investigating the possibility to grant discharge permits with the ultimate objective of achieving lower discharges.
- Involving the health ministry with any procedure or authorisation process concerning radioactive waste management.

2.1.3 Germany: Waste management issues are included in the federal government's plan to phase out nuclear energy and include the following:
Interim storage: utilities will be building interim storage facilities as soon as possible at, or close to, reactor sites. Utilities expect that it will be some five years before they have interim storage sites available to them and in the meantime they will arrange on-site temporary storage.
Transport: utilities are permitted to transport spent fuel to the centralised storage facilities, Gorleben and Arhaus, until such time that on-site facilities are available. International transports are also permitted until all reprocessing contracts have been met.
Gorleben: exploration works of the salt dome have been suspended for three to ten years during which time further clarification of technical, conceptual and safety issues are made. The federal government affirms its commitment to fully assume legal responsibility for establishing the disposal installations in due time irrespective of the nuclear phase out. Salt, granite, clay and other geological formations will all be considered. Some questions have been raised concerning the research on the Gorleben site, including:

- Overpressure from gas build-up in dense rock salt.
- Public pressure to provide a retrievability option.
- Lack of comparison to other geological formations.
- Additional safety requirements to prevent delayed criticality.

Pilot Conditioning Plant (PKA): the responsible authorities will conclude the approval process; however, the works will be limited to repairing casks.
Konrad mine shaft for LILW disposal: responsible authorities will conclude the approval process.

2.1.4 Italy: In December 1999, the government outlined plans for nuclear decommissioning and the associated waste management programmes. Three main goals were defined:

- All onsite radioactive waste should be treated and conditioned within the next ten years with the view to subsequent transport to a national repository.
- Site selection and construction of a national repository for the disposal of LLW and ILW should be accomplished within ten years. The site should also be suitable for the interim

storage of long-lived LLW, ILW and spent fuel, plus residues from former reprocessed fuel.
- Decommissioning of NPPs, with a view to returning the sites to green field status, should be achieved within the next twenty years.

The recently created subsidiary from ENEL (the responsible authority for radioactive waste management in Italy), SOGIN, will be responsible for implementing the plan. Funding (approximately 6000 billion lire (US$2.9 billion) plus 50 billion lire (US$20 million) - per year in management costs) will come partly from the ENEL decommissioning reserve and partly from a special 'nuclear component' of the electricity pricing system.

2.1.5 Slovakia: The government launched a new radioactive waste management programme in March 2000 that proposes the creation of a new waste treatment centre and national repository. Construction of the Bohunice waste treatment and conditioning centre started in 1993. It will process wastes from the decommissioning of A-1 Bohunice NPP, operational wastes from two of the four Bohunice VVERs, and institutional wastes. The redesigned Mochovce national repository could also provide new disposal facilities subject to a peer review of the IAEA under the Waste Management Assessment and Technical Review Programme (WATRP).

2.1.6 Spain and Slovenia: ENRESA, the Spanish national waste agency is assisting the Slovenian waste agency, RAO, with the development and management of a LILW repository in Slovenia. ENRESA manage El Cabril, which receives institutional waste from the medical industry as well as the nuclear power sector.

2.1.7 Spain: A new waste plan, approved by the government at the end of July 1999, delays any decisions about long-term high-level waste management until at least 2010. The plan, proposed by state-owned radwaste company ENRESA, leaves all options open for the future management of spent fuel from Spanish nuclear power plants. A further 10 years will be spent on research and development before a decision is made.

2.1.8 Switzerland: Early in March 2000, a draft revision of the Atomic Law (Kernenergiegesetz) was submitted for comment to the stakeholder groups: the public, political parties, industry and anti-nuclear groups. The main purpose for the review was to clarify the institutional role of the federal and cantonal governments in the licensing of repositories for radioactive waste. The federal government used the revised law to instigate discussion on a number of fundamental issues concerning the future of nuclear power in Switzerland. It invited comment on a number of areas including:

- Should nuclear power remain an option for future electricity production in Switzerland?
- Should the operating life of existing power plants in Switzerland be time limited?
- Should the recently developed concept for the geological disposal of radioactive waste (after an extended period of observation) be pursued?
- Should the reprocessing of Swiss spent fuel continue?
- Should the law provide full public consultation prior to the initiation of a radioactive waste disposal programme?

The consultation period ended in mid-June 2000 and it is expected that the revised law will become effective during 2001.

A new administrative order requires utilities to set aside funds over the next five years to cover the future costs of management and disposal of the spent fuel from decommissioned power plants. Such funds already exist, dating back to the start-up time of the power plants, but up to now the funds may have been used for other projects. Now they are segregated and controlled by the central government on a plant-specific basis.

2.1.9 UK: In response to the 1999 House of Lords select committee report on the management of nuclear waste, UK environment Minister, Michael Meacher, announced widespread government consultation on the issue. The Minister stressed the government's commitment to a fully comprehensive policy for managing long-lived nuclear waste. The intention is for this policy to be developed in a transparent and open-minded way to ensure maximum public acceptance before decisions are made whether to continue storage above ground, or to initiate further research into deep underground disposal. The next stage of the proceedings will include the publication of a detailed and wide-ranging consultation paper discussing the processes involved for the implementation of the various radioactive waste management options. The latest radioactive waste inventory for the UK reports a 17% decrease in the forecast of total conditioned HLW and a 26% decrease in the forecast for ILW.

2.1.10 USA: American utilities remain dissatisfied with the US Senate dealing of the nuclear waste bill, S-1287. The veto on the bill was sustained following a vote in the Senate on 2 May 2000 where ninety-nine Senators voted at 64-35. The bill requires a two-thirds majority for it to be passed.

The waste bill will permit the final disposal of spent fuel to Nevada's Yucca Mountain. The public hearing on the Yucca Mountain environmental impact assessment ended on 28 February. It is expected that the Secretary of Energy will decided whether to recommend Yucca Mountain to the President as the repository for highly radioactive nuclear waste in 2001.

2.2 Low & intermediate waste treatment

2.2.1 Canada: Construction approval was given by AECB for the modular aboveground storage (MAGS), at Chalk River Laboratories, on 19 November 1999 and the C$3 million (US$1.3 million) project started on 5 January 2000. The system will include a super-compactor to reduce the total volume of waste by a factor of twenty. Low-level wastes will be sorted, compacted, and packaged in metal containers (either conventional steel drums or purpose built steel boxes approximately 1x1x2 m). A maximum of ten storage buildings will be built each with a capacity to store up to two years of low-level waste generated both locally and elsewhere in Canada.

Resolutions have been passed supporting a local solution for the disposal of approximately one million m^3 of historic low-level radioactive wastes, located in the Ontario communities of Clarington, Hope Townshop and the town of Port Hope. The wastes resulted from the operations of the former federal Crown Corporation Eldorado Nuclear Limited at its Port Hope refinery beginning in the 1930s. The preferred waste management option is a locally developed solution to clean up and store the wastes in three long-term storage facilities, one in each of the municipalities. The facilities would be engineered to last for at least 500 years, and will cost an estimated C$230 million (US$155 million). Completion of the full project cycle is expected to take 10 years.

2.2.2 Switzerland: The final operating license for ZWILAG LLW incineration and conditioning unit was granted in March 2000.

2.2.3 UK: The Environment Agency (EA) has given permission for LLW from the former Brent Spar offshore oil installation to be brought to Britain from Norway for treatment. The Agency has authorised the import of three drums of low specific activity (LSA) waste from the decommissioned oil platform, which will be evaluated by AEA Technology. The company then intends to apply for permission to process the remaining several hundred drums of

sludge, scale and rock after the evaluation process. The waste is natural radioactive material resulting from drilling and production, and will be used to test processing methods at AEA's Winfrith plant in Dorset, UK. The waste will then be sent to BNFL's Drigg disposal site for long-term disposal.

2.2.4 USA: In March, the US Energy Secretary, Richardson, announced that the US administration had dropped a project for the construction of an incineration plant in Wyoming, following environmental opposition. BNFL was awarded the contract to compact and incinerate wastes from Idaho National Engineering and Environmental Laboratory (INEEL).

ATG Inc. has received the authorisation to construct and operate the country's first commercial mixed waste facility at its Richland centre (Washington). The permit allows ATG to treat commercial and government-generated LLW that also contain hazardous chemical contamination.

2.3 Low & intermediate waste disposal

2.3.1 Switzerland: ZWILAG, the national intermediate storage facility at Würenlingen, opened for operation on 1 January 2000 having obtained all necessary operating licences, including a licence for the operation of its high temperature plasma furnace. The furnace will convert many sources of low and intermediate level waste into a stable glass-like material suited for permanent disposal.

ZWILAG is owned by the nuclear utilities in Switzerland who have recently decided to add to the existing storage facilities (currently for spent fuel and high-level and medium-level waste) a storage hall for low-level waste. With this addition, the ZWILAG facility, together with the smaller, intermediate storage facility ZWIBEZ at the Beznau reactor site, will be able to store all radioactive waste from the five operating reactors in Switzerland for up to fifty years operation plus wastes arising from decommissioning.

2.4 Transuranic waste disposal

2.4.1 USA: The final Resource Conservation & Recovery Act (RCRA) permit for the disposal of low-level transuranic and hazardous chemical wastes at the US Department of Energy Waste Isolation Pilot Plant (WIPP) was granted from the state of New Mexico in October 1999.

2.5 Spent fuel & high level waste interim storage

2.5.1 Canada: On 20 January 2000, the Atomic Energy Control Board (AECB) of Canada approved the construction proposal for a used fuel dry storage facility at the Bruce Nuclear Power development, submitted by Ontario Power Generation (OPG). The current approval is for the construction phase. The future operation of the facility will require additional application to AECB.

2.5.2 Czech Republic: The central interim storage facility for spent nuclear fuel at Dukovany plant proceeded as planned in December 1999. The regulatory body licensed the use of the new Skoda 440/84 cask and permitted CEZ, the operator, to expand storage capacity.

2.5.3 Germany: During December 1999, nine new applications for on-site interim storage at nuclear power plants were submitted to the government. The applications came from Brokdorf, Unterweser, Stade, Grohnde, Krümmel, Brunsbüttel, Neckarwestheim, Phillippsburg and Biblis NPPs. Further applications are expected, while spent fuel transport restrictions remain in place.

2.5.4 Russia: In early 2000, the new authorities announced that they are considering the development of a spent fuel storage facility on the Kola Peninsula to provide safe storage of 60 000 spent fuel elements from nuclear submarines, currently stored in the Murmansk region. SKB, the Swedish Nuclear Fuel and Waste Management Company, welcomed this decision.

2.5.5 Spain: Preparation for a spent fuel storage facility at the Trillo reactor site restarted in August 1999 following a government order. Progress has been delayed due to opposition from the local community, who fear that the facility would become a central storage facility for Spain's spent fuel.

2.5.6 USA: In December 1999, the US NRC accepted the proposal from Private Fuel Storage (PFS), a consortium of eight utilities, to establish a spent fuel storage facility on Goshute tribal land, Utah. The go-ahead came following PFS's submission of their safety evaluation report for the project, which they consider necessary until the US DOE can allow the fuel to be moved to a permanent burial ground such as the Yucca Mountain site in Nevada. The draft environmental impact statement (EIS) met the approval of the Nuclear Regulatory Commission, the Bureau of Indian Affairs, the Bureau of Land Management, and the Surface Transportation Board. The final EIS is scheduled for completion in February 2001.

2.6 Spent fuel & high level waste disposal

2.6.1 Germany: an international team of experts declared that there was no reason that the Gorleben mine cannot meet all necessary criteria for the safe, long-term storage of spent fuel. The team was commissioned in December 1999 by the nuclear utilities to assess the results from the Gorleben salt dome site investigations. The preliminary responses from the team of experts are in contradiction to the position of the environment minister, Mr Trittin, who called for a moratorium on the works at Gorleben on 22 February 2000, and established a commission to define permanent disposal criteria. The team of experts will submit their final report by the end of 2000.

2.6.2 Japan: On 16 May, a plenary session of the Lower House passed a bill that provides a framework for the final disposal of high-level radioactive waste and sent it to the Upper House. The Upper House Committee on Economy and Industry took up the bill on 17 May. The bill requires consultation with prefecture governors and heads of local municipalities when preliminary studies of the proposed sites are made. In addition, the new law calls for the creation of an organisation responsible for HLW management.

2.7 Research

2.7.1 Belgium: ONDRAS/NIRAS is preparing the second safety assessment and feasibility interim report for the disposal of HLW in clay research programme. The completed report will be issued in late 2000. The federal authority then intends to submit the report to an international peer review committee organised by OECD/NEA.

2.7.2 Finland: Both the Finnish Ministry of Trade and Industry (KTM) and the Nuclear Safety Authority (STUK) approved the environmental impact assessment (EIA) for the final disposal of spent fuel from Loviisa and Olkiluoto at Eurojoki on the Olkiluoto site. The Eurojoki municipality supports the application and the next stage requires a decision in principle from the Finnish Council of State, which is necessary prior to the development of an underground laboratory. The government is expected to confirm that Eurojoki will get the spent fuel repository site and construction should commence around 2010, with authorisation for commissioning around 2020.

2.7.3 France: In May 2000, the government decided to postpone the site selection for a suitable granite research site for a spent fuel repository.

2.8 Transportation

2.8.1 Germany: Authorisations for domestic transport to Ahaus were issued in February 2000 to Neckarwestheim NPP and Phillippsburg NPP where spent fuel casks are already loaded. The transport of these casks is not expected before October 2000. Transporting nuclear materials outside national boundaries remains prohibited.

2.8.2 Switzerland: In summer, 1998, following the French surface contamination incident of a spent fuel consignment from the EDF's Bugey power plant, the Swiss licensing authority banned the transports of spent fuel. The ban was lifted in the summer 1999 and since then ten shipments of spent fuel to the La Hague reprocessing facility have occurred.

2.9 Clean-up

2.9.1 Norway: Towards the end of 1999, the Norwegian Radiation Protection Authority commissioned the Institute for Energy Technology to submit a plan for the removal of contaminated sediments from the Nitelva River. The radioactive discharges originate from the Institute of Energy Technology's Kjeller facility. The bulk of the contamination derives from a reprocessing facility that operated at Kjeller in the 1950's and 1960's. The plan should include provisions for the transfer of the waste to the Himdalen LLW/ILW disposal site before 2001.

2.9.2 UK: The UK Environment Agency (EA) has announced that it will introduce revised limits for five main radionuclides that are discharged from BNFL's Sellafield site. The Agency says the limits will result in a 'significant' reduction in the overall permitted discharge levels for tritium, carbon-14, technetium-99, ruthenium-106 and iodine-129. BNFL says the announcement followed three years of review and consultation by the agency and other government departments. BNFL will work within the new limits, but they will place 'restrictions' on its operational flexibility and could affect ongoing programmes, including the cleaning up of historic wastes. The review of discharges is an important element in the UK's efforts to achieve the objectives of the OSPAR Strategy with Regard to Radioactive Wastes.

3. Disposal sites - announcements & commissions

3.1 France: The French waste agency ANDRA confirmed its announcement of mid-September 1999 that it intends to construct a dedicated site for the disposal of very low level waste (VLLW), by further stating that the facility should enter into operation from 2003. The site will be on an impermeable clay layer next to the current disposal site for low- and

intermediate-level waste: the CSA centre in the Aube District. The new centre is expected to come into operation by 2002. It is designed for a total capacity of 750 000 tonnes of VLLW. 80% of the waste received will come from the nuclear industry and the rest will result from the dismantling of factories that used radioactive materials or site rehabilitation works. Waste packages will be placed in compartments dug out of the clay about 5 m deep and covered with a protective membrane. Annual deliveries are expected to be in the region of 20 000 to 30 000 tonnes.

3.2 Taiwan: In October 1999 Taipower and the Taiwanese regulatory body AEC announced that unless a suitable offshore solution for spent fuel storage arises within the next five years, Taipower will resort to on-site dry storage for several decades to come.

4. Industry progress in waste management

4.1 Treatment & conditioning

4.1.1 Canada: Phase 1 of the upgrades to the liquid wastes treatment system at the Chalk River Treatment Centre is complete and the system came into service in March 2000. The key component of the system is a new liquid waste evaporator.

4.1.2 Germany: The construction of the Karlsruhe Vitrification Facility (VEK) for HLW is going ahead as scheduled following the issue of its construction licence in 1999. The facility is expected to start by 2004.

4.1.3 Switzerland: ZWILAG, the Swiss installation for all categories of radioactive waste, and for LLW incineration and conditioning, was officially inaugurated on 27 April 2000. The facility can accept wastes from June 2000 and the first will be six shipments of spent fuel from the Leibstadt reactor. High level waste resulting from reprocessing of Swiss spent fuel at the La Hague facility is also expected.

4.1.4 Korea: A pilot cold crucible vitrification facility has been officially opened in Taejon. The plant, developed by SGN Nuclear Engineering in Partnership with NETEC (a division of KEPCO), uses a process developed by the French Atomic Energy Commission (CEA). The plant will demonstrate the technical feasibility and economic viability of using the process on intermediate and low-level waste, particularly ion exchange resins.

4.2 Interim storage

4.2.1 Finland: Fortum energy group has commissioned the second extension of the Loviisa NPP's storage facility pools. Spent fuel will be stored for 15–20 years and then it will be transported to a final repository, which is expected to be commissioned by 2020.

4.2.2 Germany: 16 interim storage facilities for spent fuel are expected in addition to the 4 existing facilities (the existing facilities are: three centralised facilities at Ahaus, Gorleben, and ZNL near Grenwald; and one on-site facility at Obrigheim). Twelve applications for on-site storage are pending for Lingen, Brokdorf, Unterwester, Stade, Grohnde, Krümmel, Brunsbüttel, Biblis, Neckarwestheim, Phillippsburg, Grafenrheinfeld and Isar.

4.2.3 Switzerland: the board of ZWILAG has authorised the construction of an additional storage building for LLW/ILW to begin in 2000 at Würenlingen. This additional facility will

mitigate the negative consequences to the nuclear power plant operators of further delays of the LLW/ILW repository at Wellenberg.

4.2.4 USA: Work on the Spent Nuclear Fuel Dry Storage Project at the Idaho National Environment and Engineering Laboratory (INEEL) began in June. The facility will provide 55 tonnes capacity for spent fuel storage for TRIGA research reactor fuel and other fuels currently stored at INEEL.

4.3 Disposal

4.3.1 Belgium: In October 1999, Belgium's nuclear waste agency ONDRAF/NIRAS signed a first local partnership agreement with the city of Dessel, near Mol, to find a suitable LLW/ILW disposal site.

4.3.2 Slovakia: Testing of the new waste treatment centre and a national repository began in March 2000.

4.3.3 Taiwan: Taipower is hoping to submit an environmental impact assessment by the end of 2000 for its site investigations at Little Chiu islet for a final repository for low level radioactive waste.

4.4 Transboundary movements & other transport

4.4.1 Belgium: The first vitrified residues transport from COGEMA La Hague to Dessel, Belgium, was successfully completed on 5 April 2000. A further two transports are planned from France to Belgium before Spring 2001.

4.4.2 Japan: The *Pacific Swan*, a purpose built nuclear carrier operated by Pacific Nuclear Transport Limited (PNTL), has successfully completed the fifth shipment of vitrified waste from France to Japan. The vessel, carrying four casks containing 104 canisters of residue from spent fuel reprocessing, left the French port of Cherbourg on 29 December 1999 and after passing through the Panama Canal, arrived at the northern Japanese port of Mutsu Ogawara on 23 February 2000. The total number of canisters received by the storage centre to date is 272, from 5 shipments.

4.5 Research

4.5.1 France: The French waste agency ANDRA continues its work on the Est site selected in December 1998 for the construction and operation of an underground research laboratory. Digging and servicing works began on 1 February 2000. The first drilling was due to start during April 2000.

4.5.2 Russia: Research for a repository for LILW on permafrost is under way and receiving funding from the European Commission's environment directorate and the Norwegian and Swedish governments.

4.5.3 Sweden: The Swedish Nuclear Fuel and Waste Management Company, SKB, plans to be able to choose at least two sites for investigations in 2001 for the disposal of spent nuclear fuel in a deep geological repository. The site characterisation, including drilling of the chosen sites, should start in 2002.

5. Site rehabilitation & decommissioning

5.1 Canada: Cogema Resources Inc. has announced its intention to shut down the Cluff Lake uranium mine by December 2000. The decommissioning plan and the comprehensive environmental report are being developed for submission with a view to obtaining the decommissioning licence in early 2001.

The federal and Saskatchewan governments are negotiating an agreement to have Gunnar and Lorado, two uranium mining and milling properties in Northern Saskatchewan that closed in 1965 and 1960 respectively, fully decommissioned. It is anticipated that the agreement will be signed in 2000, allowing work to proceed.

Most of the physical work of decommissioning the former uranium mines in the Elliot Lake area of Northern Ontario is complete. Some surface remediation work at some of the older sites that closed over 30 years ago remains and should be finished in 2000.

5.2 Italy: An estimated US$3 billion is required over the next 20 years to dismantle the four Italian nuclear power plants and establish a national repository for nuclear waste.

5.3 Kazakhstan: The fuel has been removed from the decommissioned BN-350 Aktau FBR using remotely operated equipment.

5.4 Lithuania: The decommissioning of Ignalina received Parliamentary approval at the end of April, 2000. A European Commission study estimated that the cost of decommissioning, excluding spent fuel disposal costs, would total 1 billion Euros (US$900 million) and take some 30 years. The closure and decommissioning of Ignalina is a requirement on Lithuania for its accession to the European Community. The country therefore has to generate electricity by other means and is investigating the possibility of building gas power stations.

5.5 Ukraine: The European Bank for Reconstruction and Development (EBRD) is providing finance towards the decommissioning of parts of the Chernobyl complex. A consortium involving Belgatom, Ansaldo Nucleare and SGN, has been contracted for the construction of a liquid radioactive waste processing plant. The plant will process and condition operational waste from Chernobyl-4. The liquid and sludge wastes are currently stored on site in tanks with a total volume 35 000 m^3. 2500 m^3 equivalent should be processed each year from the time that the plant is complete (currently scheduled for 2002).

A French consortium led by Framatome have been contracted to provide a packaging facility for 25 000 RBMK spent fuel elements as well as a facility to produce reinforced concrete for dry storage casks.

5.6 USA: In August 1999, Portland General Electric Company (PGE) transported the complete reactor pressure vessel from the Trojan power plant in Oregon up the Colombia River to the US Ecology LLW disposal site in Washington.

5.7 UK: The UK Atomic Energy Authority (UKAEA) has completed phase 1 of the £25 million (US$38 million), five year, decommissioning of its Windscale Piles. The first phase of decommissioning involved clearing out the air and water ducts in both piles using remote operated vehicles adapted from North Sea oil industry use. The water ducts had to be cleared of fuel debris from the 1957 fire. The piles were also separated and sealed off from the fuel storage pond. A consortium comprising of BNFL, Nukem Nuclear and Rolls Royce Nuclear Engineering Services is carrying out phase 2, the dismantling of the Pile 1 core.

In November, the UKAEA announced that it had removed the first concrete box containing reactor components from the Windscale AGR. The decommissioning project demonstrates that a full-sized power reactor can be decommissioned safely and cost effectively, using current technology and with minimum risk to the environment. The 33 MWe reactor operated from 1963-1981 to test new forms of fuel in the transition from the first generation Magnox reactors to the second generation advanced gas-cooled reactors.

A contract between Nukem Nuclear Ltd and UKAEA for the decommissioning of the Winfrith research centre was signed in March 2000. The contract is valued at DM 90 million (US$42 million) and involved dismantling the hot cell complex that was used for examining fuel rods.

6. Public acceptance

6.1 Finland: An opinion poll conducted about the decision in principle for the construction of a spent fuel repository in the municipality of Eurojoki showed that 78% of the Finnish population favour the decision.

6.2 UK: A citizen's panel has put forward a series of recommendations on how the UK should handle its radioactive waste, during a special conference dubbed 'an experiment in democracy'. The group was made up of 15 members of the public and took evidence at the London event from experts and others representing a full opinion spectrum on the issue. Later, the panel issued a series of ten conclusions, the main one that radioactive waste must be removed from the surface and stored under ground, but in a way that it can be monitored and retrieved. The panel said that cost cannot be an issue and that options should remain open to future solutions. It was further recommended that a neutral body should be appointed by the government to deal with radwaste management, including the selection of a national disposal site. The criteria for site selection should be open and public. The panel said it was not fundamentally opposed to nuclear power but took the view that there should be no expansion until radioactive waste management solutions had been demonstrated.

7. Forthcoming projects & events

7.1 France: The TFA disposal site is one of ANDRA's research projects for the disposal of radioactive wastes that cannot be placed in industrial landfills or be recycled. The other main projects concern disposal of graphite waste from decommissioned gas-cooled, graphite moderated reactors and waste contaminated by radium and other natural radioactive elements. ANDRA hopes to start operating a graphite-bearing waste centre in 2005 and a radium bearing waste centre in 2006. Current plans are focused on underground disposal. The estimated capacity for the graphite disposal site is 25 000m^3. The estimated capacity for the radium site is 100 000m^3.

7.2 Germany: The first transport of vitrified waste from COGEMA's La Hague plant to the Gorleben repository is scheduled for November 2000.

IAEA waste management reports produced between July 1999-July 2000

Nuclear and Radiological Safety - Waste Repositories
http://www.iaea.org/worldatom/Books/1999Pubs/nrswr99.shtml

Hydrogeological Investigation of Sites for the Geological Disposal of Radioactive Waste Technical Reports Series No. 391
This report, which has been prepared as part of the IAEA sub-programme on radioactive waste disposal, discusses the approaches used in the hydrogeological investigation of repository sites. It is based on experience gained in the Member States on those rock types considered as having the potential to host a repository.
(Date 1999, ISBN 92-0-100299-8)

Nuclear and Radiological Safety - Radioactive Waste Management
Safety Standard Series
http://www.iaea.org/worldatom/Books/1999Pubs/nrsrwm99.shtml

Near Surface Disposal of Radioactive Waste: Safety Requirements Safety Standards Series No. WS-R-1
This Safety Requirements publication sets out the basic safety requirements related to the disposal of radioactive wastes in near surface repositories. As a Safety Requirements publication it is supported by a number of associated Safety Guides which provide guidance on the implementation of the requirements. Its principles are derived from the Safety Fundamentals publication: *Safety Series No. 111-F, The Principles of Radioactive Waste Management*. It includes requirements for the protection of human health, for the assessment procedures needed to ensure that safety is achieved, and technical requirements for waste acceptance and for siting, design, construction, operation and closure of the repository and the post-closure phase.
(Date 1999, ISBN 92-0-101099-0)

Safety Assessment for Near Surface Disposal of Radioactive Waste: A Safety Guide Safety Standards Series No. WS-G-1.1
This Safety Guide provides recommendations on how to meet the requirements related to safety assessment in the Safety Requirements publication, Safety Standards Series No. WS-R-1, Near Surface Disposal of Radioactive Waste (1999). It addresses the subject of safety assessment for near surface disposal of radioactive waste and provides guidance on approaches to performing safety assessments in the context of near surface repositories.
(Date 1999, ISBN 92-0-101299-3)

Decommissioning of Nuclear Plants and Research Reactors: Safety Guide Safety Standards Series No. WS-G-2.1
This Safety Guide addresses the subject of how to meet the requirements for decommissioning of nuclear power plants and research reactors laid down in the Safety Requirements publication, Safety Standards Series No. WS-R-2, *Predisposal Management of Radioactive Waste, Including Decommissioning*. It provides guidance to national authorities and operating organisations on the planning and safe management of the decommissioning of such installations.
(Date 1999, ISBN 92-0-102599-8)

Decommissioning of Medical, Industrial and Research Facilities: Safety Guide Safety Standards Series No. WS-G-2.2
This Safety Guide addresses the subject of how to meet the requirements for the decommissioning of medical, industrial and research facilities where radioactive materials and sources are produced, received, used and stored, as laid down in the Safety Requirements publication, Safety Standards Series No. WS-R-2, *Predisposal Management of Radioactive Waste, Including Decommissioning*. It provides guidance to national authorities and operating organisations, particularly to those in developing countries (as such facilities are predominant in these countries) on the planning and safe management of the decommissioning of such facilities.
(Date 1999, ISBN 92-0-102099-6)

Nuclear Fuel Cycle and Waste Management - Waste Management
http://www.iaea.org/worldatom/Books/1999Pubs/nfcwmwm99.shtml

State of the Art Technology for Decontamination and Dismantling of Nuclear Facilities Technical Reports Series No. 395
This report is a review of the current state of the art of technologies used for the decommissioning of nuclear facilities, including technologies for decontamination and dismantling, waste management and remote systems. It summarises practical experience gained over the last 10 to 15 years in the field of decommissioning
(Date 1999, ISBN 92-0-102499-1)

IAEA Technical Documents (TECDOCs)
http://www.iaea.org/worldatom/Books/TecDoc/

IAEA-TECDOC-1061 Remote technology in spent fuel management. P.H. Dyck, Nuclear Fuel Cycle Material/NEFW, January 1999

IAEA-TECDOC-1068 Application of radiological exclusion and exemption principles to sea disposal. K.-L. Sjoeblom, Waste Safety/NSRW, March 1999

IAEA-TECDOC-1073 Safety measures to address the year 2000 issue at radioactive waste management facilities. E. Warnecke, Waste Safety/NSRW, April 1999

IAEA-TECDOC-1075 Radioactivity in the Arctic Seas. P.P. Povinec, Radiometrics/NAML April 1999

IAEA-TECDOC-1076 Communications on nuclear, radiation, transport and waste safety. P. Wieland, Nuclear Installation Safety/NSNI, April 1999

IAEA-TECDOC-1077 Critical groups and biospheres in the context of radioactive waste disposal. I.F. Vovk, Waste Safety/NSRW, April 1999

IAEA-TECDOC-1081 Spent fuel storage and transport cask decontamination and modification. M.J. Crijns, Nuclear Fuel Cycle and Waste Technology/NEFW, April 1999

IAEA-TECDOC-1086 Technologies for remediation of radioactively contaminated sites. D. Stritzke, Nuclear Fuel Cycle and Waste Technology/NEFW, June 1999

IAEA-TECDOC-1088 Technical options for the remediation of contaminated groundwater. E. Falck, Waste Technology/NEFW, June 1999

IAEA-TECDOC-1089 Storage of spent fuel from power reactors. P. Dyck, Nuclear Fuel Cycle and Waste Technology/NEFW, July 1999

IAEA-TECDOC-1096 Review of the factors affecting the selection and implementation of waste management technologies. V. Friedrich, Nuclear Fuel Cycle and Waste Technology/NEFW August 1999

IAEA-TECDOC-1097 Maintenance of records for radioactive waste disposal. K.W. Han, Waste Technology/NEFW, August 1999

IAEA-TECDOC-1100 Survey of wet and dry spent fuel storage. P. Dyck, Nuclear Fuel Cycle and Waste Technology/NEFW, August 1999

IAEA-TECDOC-1103 Status and trends in spent fuel reprocessing. P. Dyck / M. Crijns, Nuclear Fuel Cycle and Waste Technology/ NEFW, August 1999

IAEA-TECDOC-1105 Inventory of radioactive waste disposals at sea. R.C. Rastogi, Waste Safety/NSRW, August 1999

IAEA-TECDOC-1109 Use of natural analogues to support radionuclide transport models for deep geological repositories for long lived radioactive wastes. M. Raynal, Waste Technology/NEFW, October 1999

IAEA-TECDOC-1111 Report of the international workshop on Safety Measures to Address the Year 2000 Issue at Radioactive Waste Management and Nuclear Fuel Cycle Facilities, (Vienna, 1-2 July 1999), (Supplement to IAEA-TECDOC-1073 and IAEA-TECDOC-1087). E. Warnecke /R. Shani, Nuclear Fuel Cycle and Waste Technology/NSRW, August 1999

IAEA-TECDOC-1115 Minimization of waste from uranium purification, enrichment and fuel fabrication. V. Efremenkov, Waste Technology/NEFW, October 1999

IAEA-TECDOC-1124 On-site disposal as a decommissioning strategy. M. Laraia, Nuclear Fuel Cycle and Waste Technology/NEFW, November 1999

IAEA-TECDOC-1129 Inspection and verification of waste packages for near surface disposal. M. Raynal**,** Waste Technology/NEFW, December 1999

IAEA-TECDOC-1130 Recycle and reuse of materials and components from waste streams of nuclear fuel cycle facilities. V. Efremenkov, Waste Technology/NEFW, December 1999

IAEA-TECDOC-1131 Restoration of environments affected by residues from radiological accidents: Approaches to decision making. C. Nogueira De Oliveira, Radiation Safety/NSRW, May 2000

IAEA-TECDOC-1133 The decommissioning of WWER type nuclear power plants. M. Laraia, Nuclear Fuel Cycle and Waste Technology/NEFW, February 2000

IAEA-TECDOC-1145 Handling, conditioning and storage of spent sealed radioactive sources. M. Al-Mughrabi, Waste Technology/NEFW, June 2000

IAEA-TECDOC-1148 Site characterization techniques used in environmental restoration activities. W.E. Falck, Waste Technology/NEFW, June 2000

The Uranium Institute

The International Industrial Association for Energy from Nuclear Fuel

12th Floor, Bowater House West, 114 Knightsbridge, London SW1X 7LJ, UK
Tel: (+44) 20 7225 0303 Fax: (+44) 20 7225 0308
Email: ui@uilondon.org
Website: www.uilondon.org