RADIOACTIVE WASTE MANAGEMENT PROGRAMMES IN OECD/NEA MEMBER COUNTRIES

NETHERLANDS

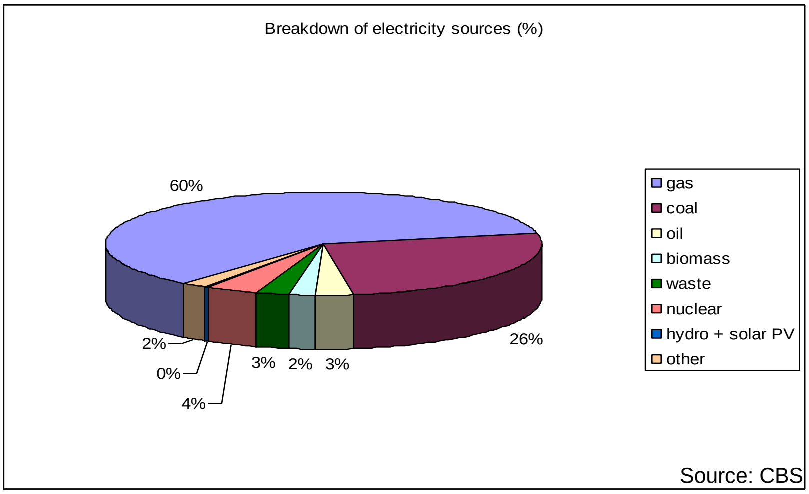
NATIONAL NUCLEAR ENERGY CONTEXT

Commercial utilisation of nuclear power in the Netherlands started in 1969. By 2005 there was one nuclear power unit (NPP Borssele) connected to the electricity grid. In 2004 it generated 3.8 TWh of electricity, 3.8% of the total electricity generated in that year.

Also in 2004, the amount of spent fuel in storage was 33 tonnes heavy metal (HM), and the amount of spent fuel arising in that year was 10 tonnes HM.

The Dodewaard NPP was shut down in 1997 and is now in the decommissioning phase. All spent fuel has been removed from the plant and transferred to Sellafield, in the United Kingdom, for reprocessing. The last shipment of spent fuel from Dodewaard was made in April 2003. In May 2002 a license was granted to GKN, the operator of the NPP Dodewaard, to bring and keep the plant in a safe enclosure. In July 2005 the phase of safe enclosure was achieved. The safe enclosure period for the NPP Dodewaard is scheduled to last 40 years. The envisaged end-point for this site is a green field condition.

The Borssele NPP was originally planned to shut down at the end of 2003 but, following an agreement between the parties forming a new government, it was decided that it will now remain in operation until 2033. This is contingent on the condition that the operator ensures that the NPP will continue to belong to the 25% safest water-cooled and water-moderated power reactors in the EU, USA and Canada.



In exchange for extended operation the operator of the Borssele NPP also committed to make substantial investments in innovative projects to support the transition to more sustainable energy management.

Conditions for new built nuclear power were formulated, but in its coalition agreement the present government stated that during its period in office no new NPP's will be constructed.

SOURCES, TYPES AND QUANTITIES OF WASTE

In the Netherlands, radioactive wastes are generated by way of nuclear power production and by the use of radioactive materials in medical, research and industrial applications. Wastes containing low or medium levels of activity consisting mainly of short-lived radionuclides are categorised as low- and intermediate-level radioactive waste (LILW). Other wastes containing higher levels of activity and those containing long-lived radionuclides are categorised as high-level waste (HLW).

Nuclear power plants

The LILW from nuclear power plants consists of disposable protective clothing, plastics, paper, metals, filters and resins. Resins are conditioned with cement at the power plant to create a stable product, while all other waste is treated and conditioned at the central treatment and storage facility of the Central Organisation for Radioactive Waste (COVRA), located in Borssele. Some 100 m^3 of conditioned LILW is generated annually, mainly at the Borssele NPP. Over a period of 100 years, the cumulative amount of LILW, including decommissioning waste, will be about 188 000 m^3.

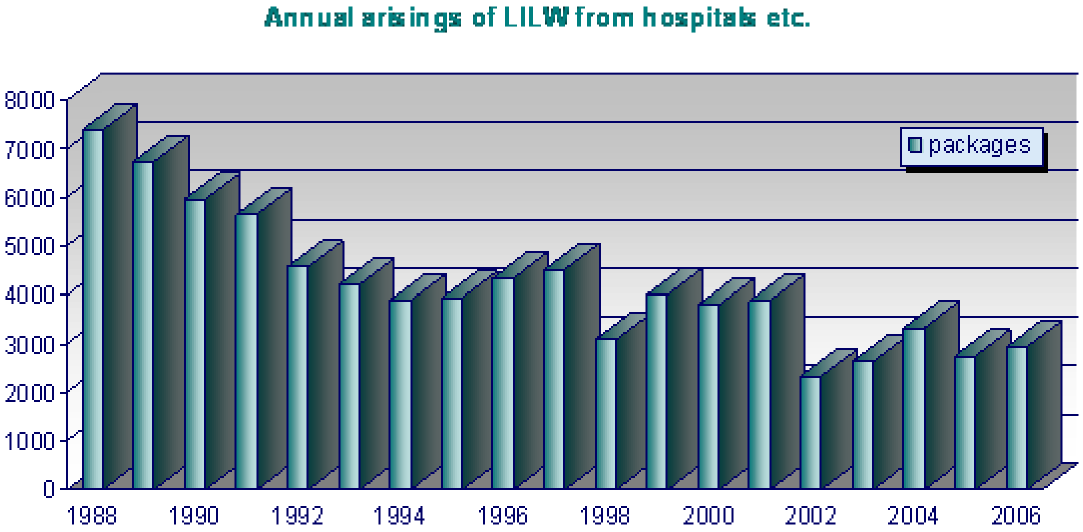
High-level waste (HLW) arises mainly from reprocessing of spent fuel, and about 10 m^3 is produced annually. Over the same period of 100 years, the cumulative amount of HLW, including decommissioning waste, will be about 3200 m^3. This includes spent fuel and radioactive waste from the research reactors in Petten and Delft.
A breakdown of the cumulative amounts of HLW by origin is represented in the table below.

Netherlands' radioactive waste
(HLW, cumulative amounts in 100 years)

Type of HLW by origin	Volume (in m^3)	
Heat-generating waste	Fuel elements and fissile residues	40
	Vitrified HLW	110
Non-heat-generating waste	Decommissioning waste	2000
	Reprocessing waste	850-900
	Other high activity waste	120

Hospitals, research and industry

The LILW arising from the use of radioactive materials in hospitals, research institutions and industry is highly varied. It includes liquids and solid materials such as paper, plastics, metals and glass, but also consists of animal carcasses, laboratory tools or equipment and sealed radioactive sources. All these forms of waste are treated and conditioned at the COVRA central treatment and storage facility. About 100 m^3 of such conditioned waste is produced annually.



TENORM

In addition to the waste described above, relatively large volumes of very low-level radioactive waste is produced during the processing of some metal ores. This waste contains naturally occurring radionuclides whose concentrations have been enhanced by the technical operations involved. Hence it is described as Technically Enhanced Naturally Occurring Radioactive Material (TENORM) waste. This waste is usually generated in the form of a relatively stable product, such as a slag or calcine, for which no further conditioning is needed. The annual production of such waste is about 1 000 m^3. It is stored in 20 ft. ISO-containers in a dedicated building at the COVRA site.

RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

Waste management policies

The Dutch policy on radioactive waste management is based a report that was presented to parliament by the government in 1984. This report covered two areas. The first concerned the long-term interim storage of all radioactive wastes generated in the Netherlands, and the second concerned the government research strategy for eventual disposal of these wastes.

Consideration of this report led, in regard to the first area, to establishment of the Central Organisation for Radioactive Waste (COVRA) in Borssele, and in regard to the second, to establishment of a research programme on disposal of radioactive waste. Pending the outcome of research into disposal, and assurance of political and public acceptance, it was decided to construct an engineered surface-storage facility with sufficient capacity for all the radioactive wastes generated in a period of at least 100 years.

The radioactive waste disposal research programme was completed in 1993, and concluded that there are no safety-related factors that would prevent the deep underground disposal of radioactive waste in salt. However, the level of public acceptance of underground waste disposal remained low. Progress of the disposal programme was stalled by lack of approval for site investigations in salt formations considered suitable for this purpose and, hence, the prospect of a waste disposal facility being available within a few decades is remote.

Programmes and projects

Current radioactive waste management policy

In 1993 the government adopted, and presented to parliament, a position paper on the long-term underground disposal of radioactive and other highly toxic wastes. This forms the basis for further development of a national radioactive waste management policy, which now requires that any underground disposal facility be designed in such a way that each step of the process is reversible. This means that retrieval of waste, if deemed necessary for whatever reason, would always be possible.

The reasons for introducing this concept of retrievability came from considerations of sustainable development. Waste is considered a non-sustainable commodity whose generation should be prevented. If prevention is not possible, the preferred option is to reuse and/or recycle it. If this in turn is not practical at present, disposal of the waste in a retrievable way will enable future generations to make their own decisions about its eventual management. This could include the application of more sustainable management options if such technologies become available. The retrievable emplacement of the waste deep underground would ensure a fail-safe situation in case of neglect or social disruption.

Although waste retrievability allows future generations to make their own choices, it is dependent upon the technical ability and preparedness of society to keep the facility accessible for inspection and monitoring over a long period. It also entails a greater risk of exposure to radiation and requires long-term arrangements for maintenance, data-management, monitoring and supervision. Furthermore, provision of retrievability in disposal deep underground is likely to make the construction and operation more complex and costly.

Thus there may be some conflict between the requirement for retrievability and the technical requirements for safe closure of a disposal facility. In practice the feasibility of keeping a geological repository accessible for retrieval purposes is restricted to a maximum of about two hundred years, depending on the type of host rock. Borehole convergence due to plastic deformation of the host rock is negligible in granite, but repositories in salt and clay without any supportive measures in the galleries, tend to close around the emplaced waste. In safety studies, this plastic behaviour and consequent convergence of salt and clay have been considered a positive asset because of enhanced containment and heat dissipation in the repository. In the Netherlands, only salt and clay are available as possible host rocks for an underground disposal facility so practical considerations indicate that the retrieval period should be limited to a realistic length of time. A progressive, step-wise procedure for repository closure is considered the most likely approach to reconciling the two objectives of retrievability and safety.

Spent fuel

The Dodewaard and Borssele NPPs have entered into contracts with BNFL, in the United Kingdom, and Areva, in France, respectively, for reprocessing the spent fuel from their reactor operations. The HLW arising from reprocessing will be returned to the Netherlands. Since the Netherlands will be unable to dispose of this HLW for the next few decades, an engineered HLW storage facility, HABOG, is being built at the COVRA site. It is planned also to store spent fuel from the research reactors in Petten and Delft in the HABOG facility.

Details of the COVRA treatment and storage facility

COVRA operates a centralised facility for management of LILW at Borssele. This facility was built between 1990 and 1992 and includes the following:

- an office building, including an exhibition centre;
- a building for the treatment of LILW;
- storage buildings for conditioned LILW;
- a building for storage of wastes from ore-processing industries, i.e. TENORM waste;
- a storage building for depleted uranium oxide, (to be completed).

The building for treatment of LILW has buffer-storage areas for the different kinds of waste, and various treatment installations. The treatment installations became operational in 1993, and currently comprise the following:

- super-compactor;
- separator for organic/inorganic liquids;
- dedicated incinerator for biological wastes;

- dedicated incinerator for organic liquids;
- shearing and cutting installation;
- cementation station;
- wastewater treatment system.

The HABOG storage facility mentioned above was commissioned at the end of 2003. It is a vault-type facility with two separate compartments. One compartment is for storage of drums and other packages containing compacted residues of fuel element cladding, hulls and ends and other HLW. The other compartment is for storage of the heat-generating, vitrified HLW from reprocessing of spent fuel from the NPPs, and of unreprocessed spent fuel from the research reactors. Waste in the first compartment does not require additional cooling, but that in the second compartment does. The vitrified HLW and spent fuel are stacked on five levels in vertical, air-cooled storage wells. The storage wells are filled with an inert gas to prevent corrosion of the canisters and are equipped with a double jacket. Cooling air flows under natural convection between the walls of the double jacket, thus avoiding direct contact of the cooling air with spent fuel or vitrified HLW canisters.

RESEARCH AND DEVELOPMENT

CORA research programme

A national research programme on retrievable disposal of radioactive waste, carried out under the scientific supervision of the Committee on Radioactive Waste Disposal (CORA), was concluded in 2001. The primary objective of the CORA research programme was study of the feasibility of retrievable disposal in salt and clay formations, and long-term storage.

The main conclusions of the CORA report were:

- Retrieval of radioactive waste from repositories in salt and clay is technically feasible. The disposal concept envisages the construction of short, horizontal disposal cells each containing one HLW canister.
- Safety criteria can be met. Even in a situation of neglect, the maximum radiation dose that an individual can incur remains far below 10 µSv/year.
- Structural adjustments to the repository design are required to maintain accessibility. This applies particularly to a repository in clay, which needs additional support to prevent borehole convergence and eventual collapse of the disposal drifts.
- Costs are higher than those for a non-retrievable repository, mainly due to maintenance of accessibility of the disposal drifts.

Although it was not included in the terms of reference, the CORA programme also addressed social aspects in a scoping study of local environmental organisations' views. In particular, it considered the ethical aspects of long-term storage of radioactive waste versus retrievable disposal. Although the results may not be representative of the views of a broader public, including other institutions with social or ideological objectives, some preliminary conclusions may be drawn as follows:

- Radioactive waste management is strongly associated with the negative image of nuclear power. As such, underground disposal is rejected on ethical grounds since nuclear power is considered unethical and a solution for radioactive waste could revitalise the use of nuclear power.
- Permanent control by the government is considered as the least harmful management option, although the possibility of social instability is recognised as a liability for which no solution can be provided.
- Although the study did not provide an opening to a consensus on the long-term management of radioactive waste, it can nevertheless be regarded as a start of stakeholder involvement.

The next steps

Because the Netherlands has adopted the strategy of storage in dedicated surface facilities for least 100 years, there is no immediate urgency to select a specific disposal site. However, further research is required to resolve outstanding issues and to be prepared for site selection in case of any change to the current timetable, arising by way of future European directives for example. The CORA committee recommended validation of some of the results of safety studies under field conditions, and co-operation with other countries, particularly on joint projects in underground laboratories, is foreseen in this context. As regards other technical aspects, it recommended that attention be given to the requirements for monitoring of retrievable repositories. Non-technical aspects will also be addressed.

In 2002 the parliament has agreed with the proposal by the Minister of the Environment to launch this research programme. However, due to difficulties with the allocation of the required budget, the programme has yet to start.

DECOMMISSIONING AND DISMANTLING POLICIES AND PROJECTS

It is generally accepted internationally that there are three basic strategies for decommissioning nuclear power plants:

i) Early dismantling, within a period of ten years.
ii) Deferral of dismantling for 40-50 years, with safe enclosure of the facility in the interim.
iii) In-situ decommissioning.

These three strategies were considered in the Environmental Impact Assessment for decommissioning of the Dodewaard NPP. The environmental impact was judged to be very small for all three strategies, and so the operator selected the least expensive strategy, namely deferred dismantling. Although the government had a slight preference for early dismantling, for various reasons, no objection was raised against the decision of the operator.

The intended end-point of the decommissioning process is return of the site to a “green field” situation. This means that, after dismantling of all the NPP structures, the site will be decontaminated to such low levels of residual radioactivity that it can be released from regulatory control for unrestricted use.

Meanwhile, under the influence of a strong preference voiced in relevant international documents[1] for direct dismantling, a change in the strategic approach occurred. In the framework of the negotiations with the operator of the NPP Borssele on a life extension until 2033, an agreement was reached on immediate dismantling after closure. This option has been agreed within the scope of the implementation of a sustainability package and has been laid down in a covenant.

TRANSPORT

Purposes of transport

In the Netherlands there are hundreds of sites on which radioactive materials are used. The activities on these sites generate wastes that must be transported to the central storage facility. COVRA collects all LILW from these sites with its own vehicles, and responsibility for the waste transfers to COVRA when loaded into its vehicle. About 1 000 m^3 of such waste is moved annually, and only by road. This is a very small quantity when compared to the total amount of radioactive material transported in the Netherlands by road, rail and air for conventional industrial and medical use.

The transport of spent fuel from the nuclear power plants to the reprocessing plant abroad is also carried out by road, by specialised foreign companies.

Safety aspects

Transport of radioactive waste is carried out strictly under the transport laws of the Netherlands. These laws implement the provisions of the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials and of associated international conventions and agreements for the various modes of transport. The safety record of waste transport in the Netherlands is outstanding.

[1] Decommissioning of Facilities using Radioactive Material, IAEA Safety Requirements No. WS-R-5, 2006

COMPETENT AUTHORITIES

Regulatory authorities

All activities involving radioactive materials, including importation, transport, use, treatment, storage, and disposal, are regulated under the *Nuclear Energy Act*, and in most cases require a licence. Licensing is a joint responsibility of the following ministries:

- the Ministry of Housing, Spatial Planning and Environment (VROM), which is the leading authority;
- the Ministry of Economic Affairs (for nuclear fuel cycle activities);
- the Ministry of Social Affairs and Employment;
- the Ministry of Health, Welfare and Sport (for medical applications).

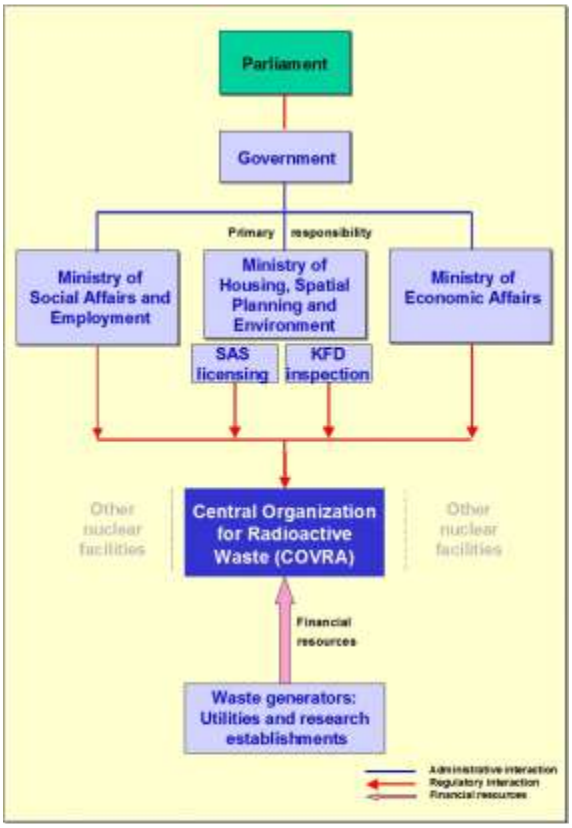
The Nuclear Safety Department of VROM is responsible for inspection and enforcement with regard to nuclear activities while the South-West Regional Inspectorate of VROM, is responsible for inspection and enforcement for all other applications of radioactive sources and materials.

Waste Management Agency

The Central Organisation for Radioactive Waste (COVRA) was established in 1982, and designated by a governmental decree in 1987 as the organisation responsible for implementing radioactive waste management in the Netherlands. It was set up originally as a private company, owned by two nuclear utilities, Dodewaard (30%) and Borssele (30%), the Energy Research Foundation (30%) and the Government (10%).

Following liberalisation of the electricity market, however, and recognising the discouraging outlook for nuclear energy in the Netherlands, the entire ownership of COVRA was transferred to the Government with effect from 15 April 2002.

Main bodies involved in radioactive waste management in the Netherlands



FINANCING

It is accepted in the Netherlands that financing of radioactive waste management should adopt the "polluter pays" principle. Hence, the fees charged by COVRA upon collection of LILW include all direct costs for transport, conditioning and storage as well as financial provisions for the costs of future storage and eventual disposal. COVRA assumes full ownership of the waste, and fees will not be adjusted retrospectively. The part of the fee attributable to costs of future disposal is placed in a capital growth fund. This fund is expected to grow to the necessary level during the 100-year period of interim storage, and its adequacy is analysed periodically.

Appropriate arrangements were made for transfer of the fund at the time of transfer of COVRA ownership to Government, and its previous owners are now discharged from any further liabilities for radioactive waste management. COVRA, and ultimately the State, now has full financial responsibility for the management of radioactive waste in the Netherlands.

PUBLIC INFORMATION

Further information may be obtained from several institutes and organisations. Addresses are given below. Visitors' centres are located at COVRA and at the nuclear power plant at Borssele.

Government

Ministry of Housing, Spatial Planning and Environment
P.O. Box 30945
2500 GX Den Haag
Website: http://www.vrom.nl/international/
Ministry of Economic Affairs
P.O. Box 20101
2500 EC Den Haag
Website: http://www.ez.nl/content.jsp?objectid=140727
E-mail: ezinfo@postbus51.nl

Research

NRG (Nuclear Research and Consultancy Group)
Petten and Arnhem
Website: http://www.nrg-nl.com/
E-mail: info@nrg-nl.com

Industry

COVRA
P.O. Box 202
4380 EA Vlissingen
E-mail: http://www.covra.nl
EPZ (nuclear power plant at Borssele)
P.O. Box 130
4380 AC Vlissingen