Ministry of Economic Affairs

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

National Report of the Kingdom of the Netherlands for the Fifth Review Conference (May 2015)

October 2014

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LIST OF SYMBOLS AND ABBREVIATIONS

Acronym	Full term	Translation or explanation (in brackets)
Awb	Algemene wet bestuursrecht	General Administrative Law Act
Bkse	Besluit Kerninstallaties, Splijtstoffen en Ertsen	Nuclear Installations, Fissionable Materials and Ores Decree
Bs	Besluit Stralingsbescherming	Radiation Protection Decree
BV	Besloten Vennootschap	Private limited company
Bvser	Besluit Vervoer Splijtstoffen, Ertsen en Radioactieve stoffen	Transport of Fissionable Materials, Ores, and Radioactive Substances Decree
BWR	Boiling Water Reactor	
BZ	(Ministerie van) Buitenlandse Zaken	(Ministry of) Foreign Affairs
COG	Container Opslag Gebouw	Container Storage Building
COVRA	Centrale Organisatie Voor Radioactief Afval	Central Organisation for Radioactive Waste
DIS	Dodewaard Inventory System	
ECN	Energieonderzoek Centrum Nederland	Netherlands Energy Research Foundation
EIA	Environmental Impact Assessment	
EZ	(Ministerie van) Economische Zaken	(Ministry of) Economic Affairs
ED	(Directie) Energie en Duurzaamheid	(Directorate of) Energy and Sustainability
EPA-n	Eenheid Planning en Advies nucleair	National Nuclear Assessment Team
EPZ	N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland	(Operator of Borssele NPP)
ERH	Energy Resources Holding	
GKN	Gemeenschappelijke Kernenergiecentrale Nederland	(Operator of Dodewaard NPP)
HABOG	Hoogradioactief AfvalBehandelings- en Opslag Gebouw	High-level Waste Treatment and Storage Building
HEU	High Enriched Uranium	
HFR	Hoge Flux Reactor	High Flux Reactor (Research Reactor of JRC at Petten)
HLW	High-level Waste	
HOR	Hoger Onderwijs Reactor	(Research reactor at the Technical University Delft)
IAEA	International Atomic Energy Agency	
IenM	(Ministerie van) Infrastructuur en Milieu	(Ministry) of Infrastructure and

Acronym	Full term	Translation or explanation (in brackets)
		the Environment
ILT	'Inspectie Leefomgeving en Transport'	Inspectorate of the ministry of I&M. KFD is part of ILT.
ISO	International Standards Organisation	
JRC	Joint Research Centre of the European Communities	
Kew	Kernenergiewet	Nuclear Energy Act
KFD	Kernfysische Dienst	Department of Nuclear Safety, Security and Safeguards (the Netherlands), inspectorate branch of the Dutch RB (and part of ILT)
LEU	Low Enriched Uranium	
LFR	Lage Flux Reactor	Low Flux Reactor
LH	Licence Holder	licensee
LILW	Low- and intermediate-level Waste	
LOG	Laagradioactief afval Opslag Gebouw	Low level Waste Storage Building
MOX	Mengoxide	Mixed Oxide
NABIS	Natuurlijke Bronnen van Ioniserende Straling	Natural Sources of Ionising Radiation
NCC	Nationaal Crisis Centrum	National Crisis Centre
NCS	Nationaal Crisisplan Stralingsincidenten	National crisis response plan radiological incidents
NDRIS	Nationaal DosisRegistratie en Informatie Systeem	National Dose Registration and Information System
NEWMD	Net-enabled Waste Management Database of the IAEA	
NMR	Nationaal Meetnet Radioactiviteit	National radiological monitoring network
NORM	Naturally Occurring Radioactive Material	
NPP	Nuclear Power Plant	
NRG	Nuclear Research & consultancy Group	
NV	Naamloze Vennootschap	Public Limited Company
NVR	Nucleaire VeiligheidsRichtlijn	Nuclear safety rule (the Netherlands)
OPERA	OnderzoeksProgramma Eindberging Radioactief Afval	National Geological Disposal Research Programme
PWR	Pressurized Water Reactor	
QA	Quality Assurance	
RB	Regulatory Body	
RID	Reactor Institute Delft	(Operator of the HOR research reactor in Delft)

Acronym	Full term	Translation or explanation (in brackets)
RIVM	Rijks Instituut voor Volksgezondheid en Milieu	National Institute of Public Health and the Environment
SAR	Safety Analysis Report	
SF	Spent Fuel	
SZW	(Ministerie van) Sociale Zaken en Werkgelegenheid	(Ministry of) Social Affairs and Employment
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material (see also NORM).	
VOG	Verarmd uranium Opslag Gebouw	Storage Building for Depleted Uranium
Wm	Wet Milieubeheer	Environmental Protection Act
WSF	Waste Storage Facility	(historical radioactive waste storage building at the Petten site)

Section A Introduction

Objective of the report

On 10 March 1999, the Netherlands signed the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, which was subsequently formally ratified on 26 April 2000 and entered into force on 18 June 2001. The Joint Convention obliges each contracting party to apply widely recognized principles and tools in order to achieve and maintain high standards of safety during management of spent fuel and radioactive waste. It also requires each Contracting Party to report on the national implementation of these principles to meetings of the parties to this Convention. This report is the fifth in its series. It describes how the Netherlands meets the obligations of each of the articles established by the Joint Convention.

Structure of the report

The report follows closely the structure as suggested in INFCIRC/604/Rev.3, "Guidelines regarding the form and structure of national reports". Where appropriate, more detailed information is provided in the Annexes. This updated report has been designed to be a 'stand alone' document to facilitate peer review. Consequently, in this fifth national report the different articles from the Joint Convention are addressed as follows:

Section A – Introduction

Section B – Article 32.1, policies and practices

Section C – Article 3, scope of application

Section D – Article 32.2, inventories and lists

Section E – Articles 18 - 20, legislative and regulatory system

Section F – Articles 21 – 26, other general safety provisions

Section G – Articles 4 – 10, safety of spent fuel management

Section H – Articles 11 – 17, safety of radioactive waste management

Section I – Article 27, transboundary movement

Section J – Article 28, disused sealed sources

Section K – General efforts to improve safety

Section L – Annexes

National nuclear programme

In the Netherlands there is one nuclear power plant (NPP) in operation: the Borssele PWR (Siemens/KWU design, net electrical output 485 MW_e), operated by EPZ, in the South-West of the country. Another NPP, the Dodewaard BWR (GE design, 60 MW_e), operated by GKN, in the East, was shutdown in 1997 and is now in Safe eEnclosure, a stage of decommissioning.

Furthermore, there are two research reactors in operation: the High Flux Reactor (HFR, 45 MW_{th}) of the EU Joint Research Centre (JRC), operated by Licence Holder (LH) the Nuclear Research & consultancy Group (NRG), located on the Research Location Petten and the Hoger Onderwijs Reactor (HOR, 3 MW_{th}) at the Reactor Institute Delft (RID), located on the premises of the Delft University of Technology. The Low Flux Reactor (LFR, 30 kW_{th}) on the Research Location Petten was taken out of operation in 2010, its decommissioning is being prepared.

In the Eastern part of the country in Almelo are the facilities for uranium enrichment of Urenco Netherlands. Licensed capacity is currently 6200 tSW/a.

The facilities of the Central Organisation for Radioactive Waste (COVRA), are located at one site in Borsele[1], in the South-Western part of the Netherlands. COVRA has facilities for the interim storage of conditioned low-, intermediate- and high-level waste. The latter category includes spent fuel of research reactors, waste from molybdenum production and waste from reprocessing of spent fuel of NPPs. COVRA also manages radioactive waste from non-nuclear origin. The COVRA buildings have been designed in such a way that, if necessary, the interim storage period may last for at least 100 years.

Policy on the safe management of spent fuel and radioactive waste

As a consequence of the relatively small nuclear program, both the total quantities of spent fuel and radioactive waste, which have to be managed, as well as the proportion of high-level and long-lived waste are modest. Most of the radioactive waste management activities are therefore centralized in one waste management organisation (COVRA). In this way as much benefit as possible is taken from the economy of scale.

Originally the Dutch radioactive waste storage facility was located at the Research Location Petten. This explains why a certain amount of 'legacy' radioactive waste is still stored at the Petten site. Currently, the low-level waste on this site is being transferred to COVRA. For the intermediate and high-level waste, several options for conditioning, repacking and transport to COVRA have been investigated. The aim is to transfer these wastes to COVRA before 2020.

The policy in the Netherlands is that all radioactive wastes must be isolated, controlled and monitored. In principle this can be done by storage in buildings and institutional control. It can also be done by landfill or (near) surface disposal and maintenance of a system of long-term institutional control and by deep geological disposal, in which case institutional control is likely to be discontinued at some moment.

The current policy assumes that the radioactive waste will be stored in buildings for a period of at least 100 years. During this period the deep geological disposal is prepared financially, technically and socially in such a way that it can be implemented after the storage period. In the current policy it is assumed the disposal facility will be ready to receive radioactive wastes in 2130.

Part of the policy is also to have a research programme on geological disposal. The programme addresses among others issues such as institutional control and prolonged retrievability of the waste from the repository. The current research programme is named OPERA.

The government policy on spent fuel management is that the decision on whether or not to reprocess spent fuel is in the first place a choice for the operator of a NPP. In the early days the operators have decided in favour of reprocessing their spent fuel for economic reasons, reuse of plutonium and reduction of the waste volume.

Regulatory Body

For the purpose of this report, the 'Regulatory Body' (RB) is the authority designated by the government as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear safety, security, radiation protection, radioactive waste management and transport safety, but also supervision and enforcement.

At present responsibilities and tasks of the RB are spread over several organisations and ministries. The Dutch Council of Ministers decided on January 24, 2014 that the RB's

[1] Borsele (with one 's') is the name of the municipality in which the village of Borssele (with a double 's') is located.

expertise in the area of nuclear safety, radiation protection and related security and safeguards, will be brought together in a single independent organisation in the Netherlands. The reorganisation will make it possible to increase the RB's efficiency and effectiveness in using available (budget and human) resources.

Currently it is foreseen that the new RB will pick up its duties starting from the beginning of 2015 accompanied by some legal steps. About one year later the final legal formalities should be completed.

The new RB will be responsible for regulating nuclear safety and radiation protection. The new organisation will have a staff of about 150 and will optimally unite and utilise the expertise and experience available within the various entities that currently constitute the RB, and exercise all of its regulatory functions. The new RB will be an Independent Administrative Authority (Dutch acronym: ZBO), it will be positioned at the ministry of Infrastructure and the Environment.

The new RB will meet international standards and will prepare legislation, draft technical regulations, develop safety requirements, issue permits, carry out inspections and enforcement, participate in regulatory research programs and provide information. The new RB will also be (jointly) responsible for emergency preparedness and response in the event of accidents which could result in the release of radiation.

More information about the RB can be found in the text on Article 20 (Section E).

Regulatory framework

The basic legislation governing nuclear activities is contained in the Nuclear Energy Act ('Kernenergiewet' or Kew). It is a framework law, which sets out the basic rules on the application of nuclear technology and materials, makes provision for radiation protection, designates the competent authorities and outlines their responsibilities. More detailed legislation is provided by associated Decrees and Ordinances.

Under the Nuclear Energy Act, a number of Decrees exist containing additional regulations related to the use of nuclear technology and materials. These continue to be updated in the light of ongoing developments.

The Nuclear Energy Act provides the basis for a system of more detailed safety regulations concerning the design, operation and quality assurance of nuclear power plants. These are referred to as the Nuclear Safety Rules (Dutch: 'Nucleaire VeiligheidsRegels', NVRs). NVRs mostly are based on IAEA Safety Guides, and in their numbering, the numbers of the corresponding IAEA guides are referenced.

The Netherlands has a small nuclear programme, but with many different types of installations. Because of the diversity present, and to allow maximum flexibility, detailed requirements are listed in the licence requirements, tailored to the characteristics of the installations, rather than in general ordinances. In the licences, the NVRs can be referenced as well as other nuclear codes and standards.

More detailed information on legislation can be found in the sections on Articles 18, 19 and 20 of the Convention.

Major developments since submission of the fourth national report

- Early 2012 plans in the Netherlands for nuclear new build (Nuclear Power Plants, NPPs) were shelved for at least a few years, considering the current economic environment and the uncertainties it introduced.
- Reprocessing contracts have been concluded for all spent fuel generated by the current operating NPP until its end of operation. Bilateral treaties have been signed by the Republic of France and the Kingdom of the Netherlands regulating for Dutch spent fuel (SF) produced until the end of operation of Borssele NPP, its receival by Areva NC in France, its reprocessing and the return of radioactive wastes from

reprocessing to the Netherlands before 31 December 2052. The Parliamentary discussion of the enabling law for this treaty was finished end 2013.

- Preparations are underway for the extension of the interim storage facilities of COVRA for high-level waste and depleted uranium.
- At the Research Location Petten, preparations are underway for establishing facilities for the screening and separation of legacy wastes, and their packaging and subsequent shipment to a conditioning facility. The conditioned waste packages will be suitable for the long-term interim storage at the COVRA facilities.
- In the past five years, the national and local governments have taken several steps to facilitate the construction of a new research reactor, the PALLAS, to replace the HFR in Petten. In 2012, the government (both national and local) decided to support the preparations for PALLAS by a loan of 80 Meuro. Plans for PALLAS were initiated by company NRG, current LH and operator of the HFR. An independent foundation has been being established that will conduct all preparatory activities required for the realisation of the new reactor.
- The Technical University of Delft has launched a project to upgrade its research reactor (project Oyster). The project is jointly financed by the university and the national government.
- The Netherlands hosted the third Nuclear Security Summit (NSS) in 2014. 58 world leaders met in The Hague on 24 and 25 March 2014 to strengthen nuclear security, reduce the threat of nuclear terrorism and to assess the progress made since the Washington Summit in 2010. Important points of attention were better security of radioactive materials and control of radioactive sources for which no further use is foreseen. An outcome of the summit was to encourage countries which have not yet done so to establish appropriate security plans for the management of spent nuclear fuel and high-level radioactive waste.
- In 2013 the last HEU fuel elements used in the Netherlands were transferred to COVRA and safely stored in the HABOG, the high-level waste treatment and storage building.

Main themes addressed at the fourth Review Conference

No specific recommendations for improvement have been made at the fourth Review Conference. The identified challenges focused on themes as specified below. In the report these themes will be covered in more detail.

- *Establishing a national programme for the management of radioactive waste around 2014*. Work on this programme is progressing. All Member States of the European Union are required to submit their programmes.
- *Preparation of licencing of the Long Term Operation (LTO) of the Borssele NPP, initiatives for nuclear new build, and associated training of staff of the Regulatory Body (RB)*. The LTO programme of Borssele NPP has been evaluated and the associated licence has been issued. The plans for nuclear new build (NPPs) have been shelved. However plans for upgrade of a Research Reactor (RR) in Delft and new build of a RR in Petten (PALLAS reactor) are underway. The RB has expanded its staff and is executing a training programme.

Section B Policies and Practices

Article 32. REPORTING
1. In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:
(i) spent fuel management policy;
(ii) spent fuel management practices;
(iii) radioactive waste management policy;
(iv) radioactive waste management practices;
(v) criteria used to define and categorize radioactive waste.

32.1 (i) Spent fuel management policy

The policy in the Netherlands on spent fuel (SF) management is that the decision on whether or not to reprocess SF is in the first place a matter of the operator of a NPP. In the early days the operators have decided in favour of reprocessing their SF for economic reasons, reuse of plutonium and reduction of the waste volume.

32.1 (ii) Spent fuel management practices

Spent fuel from the NPPs

Borssele NPP

The design of the NPP's SF pool complies with the provisions in NVR publication 2.1.10, which is an adaptation of IAEA Safety Series No. 50-SG-D10 NVR NS-G-1.4. This design ensures the removal of residual heat from the SF, while the design of the fuel storage racks in combination with a minimum of boric acid concentration in the pool water ensures non-criticality.

The NPP's SF is kept in storage for about 3 years in the SF pool at the reactor site to reduce residual heat. The actual length of the cooling period depends on the safety requirements of the transport packages and the reprocessors' specifications. According to the current contract, after that cooling period, the SF is transferred to AREVA's facilities in La Hague (France) for reprocessing. Regular transports should ensure that the fuel pool inventory is kept to a practical minimum, as required by the plant's operating licence.

The vitrified waste residues and the compacted hulls and ends from the reprocessing process are returned to the Netherlands and stored at COVRA.

A new treaty was signed by the Republic of France and the Kingdom of the Netherlands on April 20, 2012, regulating for Dutch SF produced after 2015, its receival by Areva NC in France, its reprocessing and the return of radioactive wastes from reprocessing to the Netherlands before 31 December 2052. The Parliamentary discussion of the enabling law for this treaty was finished end 2013.

The Borssele NPP has no licence to store radioactive waste; it has a licence to store SF in order to reduce residual heat. In the Netherlands all radioactive waste has to be stored at the COVRA. The producer of the waste has to bear the associated costs and COVRA takes over the responsibility.

Under previous contracts all the plutonium extracted from reprocessed SF of the Borssele NPP has been sold for reuse in MOX fuel for NPPs. Reprocessed uranium is also reused in fresh fuel. The plutonium made available under the current contract will also be reused in NPPs. The Borssele NPP has started using MOX fuel. A licence for this was granted in June 2011.

Dodewaard NPP

All SF from the Dodewaard NPP has been removed from the site. In 2003, the last batch of SF from the reactor was transferred to Sellafield (UK) for reprocessing. The separated uranium from the Dodewaard NPP has been sold to a European NPP. The separated plutonium has been sold to AREVA and NDA. The resulting vitrified waste was returned from Sellafield to the Netherlands in April 2010, and shipped to COVRA for long-term storage.

Spent fuel from the research reactors

Spent Fuel from research reactors is stored in the SF pools, prior to being shipped to COVRA for long-term storage. Usually a cooling period of five years is applied before the SF is transferred to COVRA. Periodic transports are arranged to ensure that the pool always has sufficient storage capacity available to accommodate all elements present in the reactor core.

Since May 2006 the HFR only uses low-enriched uranium (LEU). This is in line with the worldwide move to abandon the use of high-enriched uranium (HEU) for non-proliferation reasons. The last HEU fuel elements from the HFR were transported to COVRA in March 2011.

The consumption of fuel in the LFR was very low. The original fuel elements were still in use till the shut-down of the reactor in 2010. All SF has been transferred to COVRA. The LFR is not discussed further in this report.

In Delft at the HOR some SF is stored in the spent fuel pool as well. In 1998 a conversion of HEU fuel to LEU fuel was started. With the last HEU fuel element removed from the core on 10 January 2005 the conversion was completed. The last HEU fuel elements from the HOR were shipped to COVRA in May 2011.

32.1 (iii) Radioactive waste management policy

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

The report led to the establishment of the COVRA in Borsele, and to the launch of a research programme on disposal of radioactive waste. Pending the outcome of research on 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 waste generated in a period of at least 100 years.

By doing so the government via COVRA keeps control over all the radioactive waste generated in the Netherlands, whereas in the mean time research into the best long-term solution can be done without pressure of time.

Policy: Long-term above-ground storage

The policy in the Netherlands is that all hazardous and radioactive waste must be isolated, controlled and monitored. In principle this can be achieved by storage in buildings and institutional control. It can also be achieved by landfill and near-surface disposal and maintenance of a system of long-term institutional control, or by deep geological disposal, for which institutional control is likely to be discontinued at some moment.

For the options mentioned, the degree of required institutional control is the highest for storage in buildings and the lowest for geological disposal. When containment is required over periods of time longer than the existence of present society can be foreseen, doubt may be raised on the capacity of society to fulfil the control requirement.

It should be realized that the cumulative waste volume that is actually in storage right now, is about twenty-eight thousand m^3. For such a small volume it is not economically feasible to construct a geological disposal facility at this moment. The waste volume anticipated to be collected in a period of 100 years was judged as large enough to make a disposal facility in the future viable. It is intended to dispose of all types of radioactive waste in the disposal facility, ranging from LILW to heat-generating high-level waste (HLW) since this is the only way to make a national geological disposal facility in the Netherlands economically feasible.

For the interim above-ground storage period considered, storage in buildings is required. This creates at least five positive effects:

- There is a period of 100 years available to allow the capital growth fund to grow to the desired level. This brings the financial burden for today's waste, that the generator has to pay, to an acceptable level;
- In the period of 100 years the heat-generating HLW will cool down to a situation where cooling is no longer required;
- A substantial volume of the waste will decay to a non-radioactive level in 100 years and has not to be stored in a deep geological disposal;
- In the mean time research into the best long-term solution can be done without pressure of time. And in 100 years from now new techniques or management options can become available;
- During the next 100 years an international or regional solution may become available. For most countries the total volume of radioactive waste is small. Co-operation creates financial benefits, and could result in a higher safety standard and a more reliable control.

Consequently, it was concluded in the policy report of 1984 that a suitable solution for the Netherlands is to store all radioactive waste at one place, to take over by the government the responsibility for the waste in return of a sufficient payment by the producer of the waste in order to keep control over all the radioactive waste generated in the Netherlands. Therefore the government decided to build at one location buildings specially designed for the storage of radioactive waste, to store the waste in those buildings for a period of at least 100 years and to prepare financially, technically and socially a deep geological disposal during this period in such a way, that it can really be implemented during the interim storage period. Of course after these 100 years society will have the freedom to choose between a continuation of the storage for another 100 years, to realise the final disposal, or to use new techniques or management options that may become available during the period of interim storage.

The policy in the Netherlands allows extension of the envisaged above-ground storage period of 100 years. The reasoning is that future developments and/or innovations may necessitate such an extension. The design of the above-ground facilities can accommodate such flexibility.

Transparency of nuclear activities and communication to the public are the cornerstones of the chosen solution: to build confidence in the regulator and the safety of radioactive waste management; to enable a dialogue among stakeholders and/or public debate on the final disposal.

Policy: Eventual geological disposal of radioactive waste

The geological conditions in the Netherlands are in principle favourable from the perspective of geological disposal of radioactive waste. In the northern part of the country there are deep lying, large salt formations with a good potential as disposal site. Clay formations are ubiquitous at varying depth in the whole country. Extensions of the Boom clay, which qualifies as potentially suitable host rock for a repository in Belgium, also abounds in the south west of the Netherlands (see Figures 1 and 2).

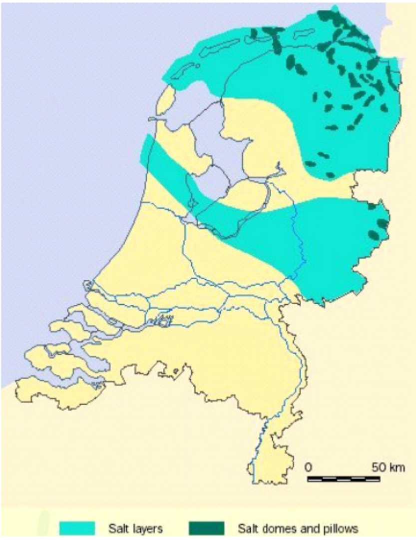

Figure 1 Distribution of salt formations

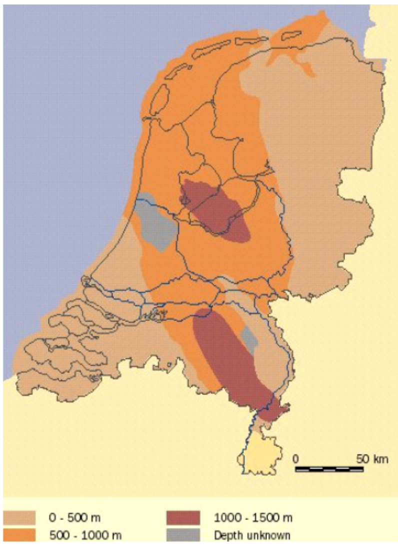

Figure 2 Distribution and depth of the Boom Clay

Policy: Supporting research programmes – past and present

In 1993 a preliminary radioactive waste disposal research programme was completed, and it was concluded that there are no safety-related factors that would prevent the geological 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 that are considered suitable for this purpose and, hence, the prospect of a waste disposal facility being available within the next few decades was remote.

In 1993 the government adopted, and presented to parliament, a position paper on the geological disposal of radioactive and other highly toxic wastes. This formed the basis for further development of a national radioactive waste management disposal policy. The new policy required that any geological 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 still be possible for decades up to several centuries after closing the repository, leaving the possibility to future generations to apply other management techniques, if available.

The reasons for introducing this concept of retrievability originated 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, 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 options become available. The retrievable emplacement of the waste in the deep underground would ensure a 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 in the deep underground is likely to make the construction and operation more complex and costly.

In 1995 the so-called Commission Disposal Radioactive Waste (CORA) research programme was initiated as a continuation of former research, aiming at demonstrating the technical feasibility of a retrievable underground repository in salt and clay formations. In 2001 the programme was concluded. The main conclusions 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. In particular, it considered the ethical aspects of long-term storage of radioactive waste versus retrievable disposal. The results may not be representative of the views of a broader public, including other institutions with social or ideological objectives, but some preliminary conclusions could be drawn. The following statements reflected the position of many environmental groups:

- radioactive waste management is strongly associated with the negative image of nuclear power amongst those groups. As such, geological 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;
- long-term control by the government on dedicated surface storage facilities 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;
- while it is clear that widely different views exist between stakeholders, this exchange of views can be considered as the start of a dialogue, which is a prerequisite for any solution.

Because the Netherlands has adopted the strategy of storage in dedicated surface facilities for at least 100 years, there is no immediate urgency to select a specific disposal site. However, further research is required to resolve outstanding issues, to preserve the expertise and knowledge, 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 was recommended that attention should be given to the requirements for monitoring of retrievable repositories. Non-technical aspects also need to be addressed.

After some years of delay, in July 2011 the third national research program on radioactive waste, OPERA started. COVRA has been charged to conduct this 10 million euro research program while the costs are divided between the nuclear industry and the government. The goal of OPERA is to evaluate the existing safety and feasibility studies in a so-called safety case. The current considerations with regard to the safety of a repository for radioactive waste were made more than ten to twenty years ago and a reevaluation in the light of current knowledge was considered necessary. The results of OPERA are expected to be available around 2016.

The option of a multinational solution

For the establishment of a geological disposal facility, the Netherlands policy does not exclude the option of international cooperation. The national policy includes the option to establish a national geological disposal as well as the option to establish a multi-national disposal facility. The costs of a national facility will be high for a country with a small nuclear programme; cooperation with other countries may reduce these costs because of the economy of scale.

Together with a core group of six other European countries, the Netherlands have representatives in the ERDO (European Repository Development Organisation) working group. The working group investigates the feasibility of establishing a formal, joint waste management organisation in Europe that can work on a multi-national solution parallel to the national programmes.

National Programme satisfying Council Directive 2011/70/Euratom

In parallel with OPERA, from which results are expected around 2016, the government will develop a national programme for implementation of the policy on spent fuel and radioactive waste management. It will cover all stages of spent fuel and radioactive waste management from generation to disposal. This national programme is expected somewhere in 2015 and is a requirement of the Directive on the management of spent fuel and radioactive waste (Council Directive 2011/70/Euratom). It will be based on the existing and projected national inventory of radioactive waste and spent fuel. The national programme will include:

- the overall objectives of the Dutch national policy of spent fuel and radioactive waste management;
- the significant major milestones, clear timeframes and responsibilities for the implementation and the achievement of these milestones in light of the overarching objectives of the national programme;
- an inventory of all spent fuel and radioactive wastes and estimates of future quantities, including those from decommissioning of nuclear installations and cyclotrons, clearly indicating the present location and the amount of the radioactive waste and spent fuel in accordance with appropriate classification of the radioactive waste;
- the concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;
- the concepts and or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained, and the means

to preserve knowledge of that facility awaiting the complete decommissioning of the installation;

- the research, development and demonstration activities that are needed in order to implement solutions for the management of spent fuel and radioactive waste;
- the responsibility for the implementation of the national programme and the key performance indicators to monitor progress in the implementation;
- an assessment of the national programme costs, the underlying basis and hypotheses for that assessment, which must include a profile over time;
- the financing scheme(s) in force;
- a transparent policy or process as described in the paragraph below.

Since increasing public awareness could lead to challenges regarding the acceptance for radioactive waste disposal, it is realized that the public should be given the necessary opportunities to participate effectively in the process of decision-making on spent fuel and radioactive waste management in accordance with the national legislation and international obligations. It is also important to ensure that necessary information on the management of spent fuel and radioactive waste is made available to workers in the nuclear and related industry and to the general public. Information will be made available to the public in accordance with national legislation and international obligations, provided that this does not jeopardise other interests such as, inter alia, security, as layed down in national legislation or international obligations. This transparant process will also be specified in the national programme to be published.

32.1 (iv) Radioactive waste management practices

Storage facilities

Most of radioactive waste produced in the Netherlands is managed by COVRA. There are some exeptions: radioactive wastes with a half-life less than 100 days, is allowed to decay at the sites where it is being generated and large amounts of NORM waste is disposed of (or reused) at (two designated) landfills.

Transferral of the radioactive waste to COVRA includes transferral of the property and liabilities. The fact that COVRA takes full title of the waste is reflected in the Transfer document and laid down in the General Conditions of COVRA. COVRA operates its facilities at one single site in an industrial area in Borsele in the South-West of the country.

Low- and intermediate-level waste

LILW arises from activities with radioisotopes - in among others - industry, research institutes and hospitals. It includes lightly contaminated materials, such as tissues, plastic -, metal - or glass objects, or cloth. In addition, drums with waste in cement, originating from nuclear power plants, and delivered in a conditioned form to COVRA contribute to the growing amount of LILW at COVRA. In 2013 about 237 m^3 of conditioned LILW was added to the inventory, which amounted to a total of 10,572 m^3 at the end of 2013. Without correction for decay this corresponded to a total of 2,282 TBq. The radioactivity is dominated by the radionuclides Co-60, H-3 and Cs-137.

As mentioned earlier, a substantial volume of the waste will decay to a non-radioactive level in 100 years. To keep track of the actual level, the radioactive content of each package is recorded in a database. Thus, the expected date at which the radioactivity has decayed below the clearance levels can be calculated. In the Netherlands the clearance levels are numerically equivalent to the exemption levels. These exemption levels have been laid down in the Euratom Basic Safety Standards[2]. Exceptions are Ra-226, Ra-228, and Co-60. The clearance levels of these radionuclides, that are applied in the Netherlands (1 Bq/g), differ from those in the Basic Safety Standards (10 Bq/g).

NORM and depleted U

Wastes from ores – and other raw materials – generated in processing industries sometimes have natural radioactivity concentrations far in excess of the exemption levels as specified in Table 1 of the Euratom Basic Safety Standards. In case the exemption levels are exceeded by a factor of 10 in the Netherlands a licence is required. Below this factor 10 exceeding level – but above the exemption levels – a notification to the competent authority is sufficient. Furthermore, the legislation for Naturally Occurring Radioactive Material (NORM) and/or Technically Enhanced Naturally Occurring Radioactive Material allows a NORM generating industry – under certain conditions - to mix up NORM with other materials for recycling purposes as long as this activity does not result in an increased risk to man and environment. Mixing up NORM with the solitary aim of dilution is not allowed, only for recycling purposes.

NORM includes depleted uranium originating from the uranium enrichment facility of URENCO. The tails that remain after the enrichment process are not considered as waste as long as they are available for re-enrichment. If URENCO decides that re-enrichment is not economically feasible, the tails are converted to solid uranium oxide in France and stored at the COVRA site. The uranium oxide is stored in standardized 3.5 m^3 containers (DV-70) in a custom-built modular storage building. One storage module with a storage capacity of 650 containers became operational in 2004, two more in 2008 and with the construction of modules 4, 5 and 6 in 2011 the depleted uranium storage building (VOG) was completed. At the end of 2013, a total of 3100 containers was kept in storage in the VOG. The planning is to start in 2014 with construction of a second depleted uranium storage building (VOG-2) with three, larger storage modules. Each module will have a capacity of 2,193 containers. A licence application for extending the storage capacity has been submitted.

NORM also includes waste from phosphor production with an activity between 500 and 4000 Bq/gram dominated by polonium-, bismuth- and lead- isotopes. Depending on the initial activity the material will decay to exemption/clearance levels within 100 to 150 years. So, after such a foreseen storage at COVRA as radioactive waste, the material can be disposed of as conventional waste. The waste is stored in large freight containers in a modular building specifically built for this purpose. At the end of 2013 a total of 238 containers was kept in storage in the container storage building (COG).

The quantities of NORM waste stored on other sites than COVRA are not recorded at a central level. A large quantity of this waste has radioactivity concentrations below the exemption levels. These levels have been specified in an ordinance on radiation protection[3]. As far as possible this waste is reused as additives for the preparation of building materials, e.g. for road construction. Other waste, particularly mixed waste, containing both radioactive material and other hazardous material is destined to be disposed of in repositories for chemical waste. Consequently, the quantities of NORM kept in storage may vary considerably from year to year.

NORM materials with radioactivity concentrations in excess of the exemption limits are also stored at sites of raw materials processing industries. The quantities are estimated to add up to about 50,000 tonnes. It is important to note that these stored NORM materials are not considered waste. It concerns for instance bulk materials for which future use is foreseen, such as uranium or thorium bearing ores or zirconium oxides.

[2] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of health of workers and the general public against the dangers of ionizing radiation, Official Journal of the European Communities, 1996, 39 (L159) 1-114

[3] 'Uitvoeringsregeling stralingsbescherming EZ' (Dutch). This ordinance is referenced in the Decree on Radiation Protection.

Generally speaking, the activity concentrations of these materials are above the exemption limits, but below ten times the exemption limits, which implies that a notification to the authorities is sufficient. If the activity concentrations exceed ten times the exemption levels, a licence is required.

In case NORM material is declared as waste, and the activity concentration exceeds the exemption levels ten times or more, it is sent to COVRA. Examples of this kind of waste are Po- and Pb-bearing waste from high temperature phosphorus production. In case NORM is declared as waste, and the activity concentration levels are less than ten times the exemption levels, it can be disposed of at two dedicated disposal sites for hazardous materials. It should be noted that signifiant volumes of NORM materials of which the activity concentration exceeds the exemption levels ten times or more are mixed for the purpose of 'reuse' at landfills for chemical waste.

High-level waste

The HLW at COVRA consists partly of heat-generating waste (vitrified waste from reprocessed spent fuel from the NPPs in Borssele and Dodewaard, conditioned spent fuel from the research reactors and spent uranium targets from molybdenum production) and partly of non-heat-generating waste (such as hulls and ends from fuel assemblies and waste from nuclear research and radio-isotope production).

Because of the long-term storage requirement, the design of the high-level waste treatment and storage building (HABOG) includes as many passive safety features as possible. In addition, precautions are taken to prevent degradation of the waste packages. The heat-generating waste is stored in an inert noble gas atmosphere and cooled by natural convection. In the design of the building all accidents with a frequency of occurrence larger than once per million years were taken into account. The design must be such that these accidents do not cause radiological damage to the environment.

The non-heat-generating waste is, remotely controlled, stacked in well-shielded storage areas. The heat-generating waste such as the vitrified residues is put into vertical storage wells cooled by natural ventilation. The HABOG storage facility is in full operation since 2003. At the end of 2013, a total of 85.6 m^3 HLW and spent fuel (SF) was kept in storage.

Preparations are underway to expand the storage capacity of HABOG with two additional vaults for the storage of heat-producing high-level waste. The planning is to start in 2015 with construction. A licence application for extending capacity has been submitted.

The spent fuel elements of the research reactors are delivered to COVRA in a cask containing a basket with circa 33 elements. Inside COVRA the basket with elements is removed from the cask and placed in a steel canister, which is welded tight and filled with an inert gas (helium). These sealed canisters are placed in wells, in the same way as the vitrified residues. The wells are filled with another inert gas (argon) to prevent corrosion of canisters with spent fuel elements or vitrified waste. Details of the HABOG design are presented in the text under article 7 (i).

There still is an amount of legacy waste present in the WSF building at the Research Location Petten. A minor fraction of this waste in the Dutch system classifies as 'high level waste', but in many countries it would classify as 'intermediate level' waste. This waste, resulting from four decades of nuclear research at that facility, exists of fuel material residues (spent uranium targets and irradiated fuel) and fission and activation products. Currently, the low-level waste on this site is being transferred to COVRA. For the intermediate and high-level waste, a project is underway to package and condition the waste for storage at COVRA.

32.1 (v) Criteria used to define and categorize radioactive waste

Radioactive waste is defined as: a radioactive material for which no further use, reuse, or recycling is foreseen and which will not be discharged. This definition is given in the Radiation Protection Decree, the Bs[4].

As stated before, most of the radioactive waste is collected and managed by COVRA. Long-term storage of all radioactive waste in buildings has been chosen as the preferred national policy. Disposal in suitable geological formations is envisaged in due time. Consequently, classification of the waste is based on practical criteria both derived from the need to limit exposures during the prolonged storage period and from the final disposal route.

Roughly there are three waste categories, namely LILW, HLW (non-heat-generating) and HLW (heat-generating).

No distinction is made between short-lived and long-lived LILW as defined by the IAEA Safety Guide on Classification[5]. The reason is that shallow land burial is not applicable for the Netherlands. All categories of waste will be disposed of in a deep geologic repository in the future. Due to the small amounts of radioactive waste, no separate disposal facilities for LILW and HLW are envisaged. The waste in the storage buildings for LILW is segregated according to the scheme in Table 1.

Table 1 Categories of LILW classified by type of radioactivity

Category	Type of radioactivity
A	Alpha emitters
B	Beta/gamma contaminated waste from nuclear power plants
C	Beta/gamma contaminated waste from producers other than nuclear power plants with a half-life longer than 15 years
D	Beta/gamma contaminated waste from producers other than nuclear power plants with a half-life shorter than 15 years

HLW, heat-generating, consists of the vitrified waste from reprocessing of spent fuel from the two nuclear power reactors in the Netherlands (Borssele and Dodewaard), the spent fuel of the two research reactors (Petten and Delft) and the spent uranium targets of the molybdenum production.

HLW, non-heat-generating, is mainly formed by the reprocessing waste other than the vitrified residues. It also includes waste from research on reactor fuel and some decommissioning waste. HLW, heat-generating, and HLW, non-heat-generating, are stored in separate compartments of the HABOG.

[4] Dutch: Besluit stralingsbescherming, Bs

[5] Classification of Radioactive Waste, IAEA Safety Series No. 111-G-1.1, IAEA, Vienna, 1994

Section C Scope of Application

Article 3. SCOPE OF APPLICATION

1. This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.

2. This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.

3. This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defence programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.

4. This Convention shall also apply to discharges as provided for in Articles 4, 7, 11, 14, 24 and 26.

3.1 Spent fuel

Spent fuel from the nuclear power stations, which has been transferred to La Hague for reprocessing, will not be taken into account in the spent fuel inventory as long as it is at the reprocessing plant.

3.2 Radioactive waste

The Netherlands has decided that waste originating from naturally occurring radioactive materials (NORM) in quantities or concentrations exceeding the exemption limits specified in the Dutch regulation on Radiation Protection, shall be declared as radioactive waste under the scope of this Convention.

3.3 Military or defence programmes

The Netherlands has decided that waste originating from military or defense programmes will not be addressed in this report, unless this waste has been transferred permanently to and managed within civilian programmes.

Section D Inventories and Lists

Article 32, paragraph 2

This report shall also include:

(i) a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;

(ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;

(iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;

(iv) an inventory of radioactive waste that is subject to this Convention that:

(a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;

(b) has been disposed of; or

(c) has resulted from past practices.

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;

(v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

32.2 (i) Spent Fuel Management Facilities

In Table 2, a list of the spent fuel (SF) management facilities subject to this Convention, their location and essential features is given.

Table 2 Spent Fuel Management Facilities

Location	*Spent fuel storage facility*	*Features*
Borsele COVRA	Dry storage in vaults	COVRA facility for treatment and storage of HLW and SF (HABOG)
Borssele NPP	Fuel storage pool	Pool belongs to nuclear power station where SF is stored temporarily before shipment to La Hague for reprocessing
Petten	Fuel storage pool of HFR	Associated with the HFR Research Reactor; SF is stored temporarily awaiting shipment to COVRA
	Dry storage in drums in WSF	WSF; legacy SF samples from HFR irradiation experiments; stored in concrete-lined vaults. To be transferred to COVRA
Delft	Fuel storage pond of HOR	Belongs to HOR Research Reactor; SF is stored temporarily awaiting shipment to COVRA

32.2 (ii) Inventory of spent fuel

In this section the inventory of SF present in the COVRA facilities (HABOG building) is specified. Currently SF of the research reactors amounts to 5.4 m^3 SF (45.8 PBq). Uranium targets amount to 1 m^3 (2.1 PBq).

32.2 (iii) Radioactive waste management facilities

In Table 3 a list of the radioactive waste management facilities subject to this convention is given. Only those radioactive waste management facilities are reported whose main purpose is radioactive waste management. This means that small-scale waste management departments of hospitals, research institutes or industries which store radioactive waste for decay or which perform simple operations such as compacting waste awaiting collection by COVRA, are not included in the list.

Waste storage departments of the NPP Borssele and of the research reactors are not specifically mentioned either, because a general licence condition obliges LHs to limit their inventories by transferring their radioactive waste periodically to COVRA. This does not apply for waste with a half-life of less than 100 days, which is allowed to be stored for decay on site. NRG is not allowed to store new waste in the WSF; this waste has to be delivered to COVRA.

Table 3 Radioactive Waste Management Facilities

Location	***Radioactive waste storage facility***	***Features***
Borsele COVRA	Dry storage in vaults	COVRA facility for treatment and storage of HLW and SF (HABOG)
	Dry storage of LILW in conditioned form in drums	COVRA facilities for treatment and storage of LILW (AVG and LOG)
	Dry storage of NORM waste in containers	COVRA container storage facility (COG)
	Dry storage of small containers of depleted uranium oxide.	COVRA facility for storage of U_3O_8; this waste may be retrieved and converted (VOG)
Petten	Dry storage of unconditioned waste in drums.	WSF; partly HLW from irradiation experiments; to be transferred to COVRA after conditioning

32.2 (iv) Inventory of radioactive waste at COVRA

The inventory of radioactive waste, stored at the COVRA facilities has been specified under section 32.1(iv) in relation with the waste management practices, but is summarized below:

HLW (excluding SF)	80 m^3	2,323 PBq
LILW	10,572 m^3	2,282 TBq
NORM wastes	17,322 m^3	

32.2 (v) Nuclear facilities in the process of being decommissioned

In Table 4 a list of nuclear facilities in the process of being decommissioned is given.

Table 4 Nuclear facilities being decommissioned

Facility	***Date of final shut down***	***State of decommissioning***
Dodewaard NPP	1997	Safe enclosure as of 01/07/2005
LFR	2010	Shut down, fuel removed. A decommissioning licence has been granted.

Section E Legislative and Regulatory System

Article 18. IMPLEMENTING MEASURES Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention

18 Implementing measures

A legislative and regulatory system necessary to implement the obligations under this Convention is in place. Details of this system are given in the text under Article 19.

In 10 March 1999, the Netherlands signed the Joint Convention, which was subsequently ratified on 26 April 2000 and entered into force on 18 June 2001.

Article 19. LEGISLATIVE AND REGULATORY FRAMEWORK 1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management. 2. This legislative and regulatory framework shall provide for: (i) the establishment of applicable national safety requirements and regulations for radiation safety; (ii) a system of licensing of spent fuel and radioactive waste management activities; (iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence; (iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting; (v) the enforcement of applicable regulations and of the terms of the licences; (vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management. 3. When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

19.1 Legislative and regulatory framework governing the safety of spent fuel and radioactive waste management

19.1.a. Overview of national legislative framework

The legal framework in the Netherlands with respect to nuclear installations can be presented as a hierarchical structure. Refer to the diagram in Figure 3.

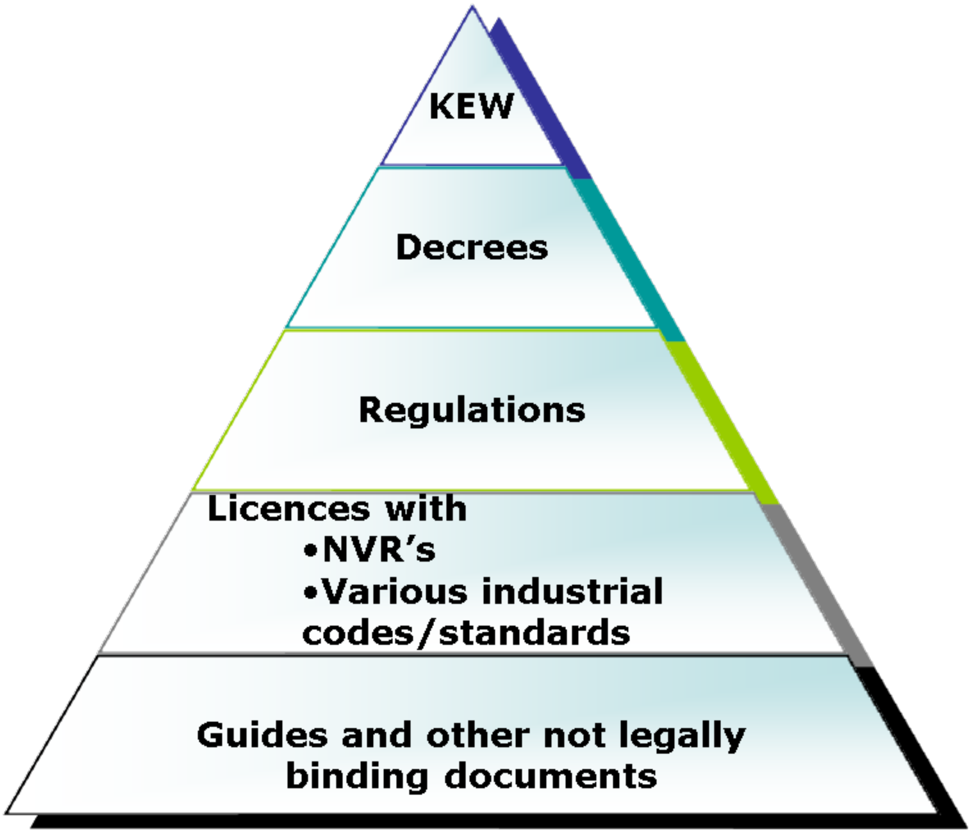

Figure 3 Simplified representation of the hierarchy of the legal framework for applications of nuclear technology

Several laws apply to the governance of radioactive waste and spent fuel. The Nuclear Energy Act (Kew[6]) is the most prominent law governing nuclear activities and the proper management of these materials. It is a framework law, which sets out the basic rules on the application of nuclear technology and materials, makes provision for radiation protection, designates the competent authorities and outlines their responsibilities.

Other important acts are:

- Environmental Protection Act ('Wet milieubeheer', Wm)
- General Administrative Act ('Algemene wet bestuursrecht', Awb)
- Act on Liability for Nuclear Accidents ('Wet aansprakelijkheid kernongevallen', WAKO)
- Water Act ('Waterwet', Ww)
- Environmental Planning Act ('Wet algemene bepalingen omgevingsrecht', Wabo)

Subordinate to the Nuclear Energy Act, a number of Decrees exist containing additional regulations related to the use of nuclear technology and materials. These continue to be updated in the light of ongoing developments. Notable is the recent update of the Decree on Radiation Protection (Bs).

At a lower level there are the Ordinances[7]. These can be issued by the minister responsible for conducting the regulatory process under the Nuclear Energy Act.

[6] Dutch: KEW, 'Kernenergiewet'
[7] Dutch: 'Ministeriële Regelingen', MR

At an even lower level there are regulations and guides issued by the RB: the Nuclear Safety Rules (Dutch: NVRs[8]). The Nuclear Energy Act (Article 21.1 of the Kew) provides the basis for this system of more detailed safety regulations concerning the design, operation and quality assurance of (mainly) nuclear power plants. In the NVRs the WENRA Reactor Safety Reference Levels published in 2008 have been implemented.

The Netherlands has a small but diverse nuclear programme. There are many different nuclear installations; a power reactor, a permanently shut down power reactor in Safe Enclosure, three research reactors, hot cell facilities, radiological laboratories, an enrichment plant and a central national radioactive waste storage facility. Because of this diversity and to allow maximum flexibility, specific requirements are listed in the licence, tailored to the characteristics of the installations, rather than in general ordinances. In the licences, NVRs can be referred to as well as to other codes and standards.

More details on the legislative framework can be found under 19.1.c.

19.1.b. Overview of regulatory and organisational framework

The minister of Economic Affairs (EZ) is the primarily responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the RB.

Several other ministers also have responsibilities in specific areas related to the use of radioactivity and radiation. The ministry of EZ is the coordinating ministry for all the issues related to the Nuclear Energy Act.

For the purpose of this report, the RB is the authority designated by the government as having legal authority for conducting the regulatory process, including issuing authorizations, supervision and enforcement and thereby regulating nuclear safety, radiation protection, radioactive waste management and transport safety.

The separate entities of the RB currently reside in several ministries, but a major reorganisation is ongoing, establishing one single new RB. For more information on the pending reorganisation, please refer to the Introduction of the present report.

The separate entities of the RB operate with working agreements under the responsibility of the minister of EZ.

For more information on the organisation and functioning of the RB, refer to the text in the present national report on Article 20 of the Convention.

19.1.c. Main elements of the Acts and Decrees

19.1.c.1 Nuclear Energy Act (Kew[9])

With regard to nuclear energy, the Act considers (Article 15b):

- the protection of people, animals, plants and property;
- the security of the State;
- the storage and safeguarding of fissionable materials and ores;
- the supply of energy[10];
- the payment of compensation for any damage or injury caused to third parties;
- the observance of international obligations.

Within the framework of the Nuclear Energy Act, fissionable materials are defined as materials containing up to a certain percentage of uranium, plutonium or thorium (i.e. 0.1% uranium or plutonium and 3% thorium by weight). Ores are defined as raw

[8] Dutch: 'Nucleaire Veiligheids Regels', NVRs

[9] Dutch: 'Kernenergiewet', Kew

[10] A modification of the law is being prepared by which 'supply of nergy' no longer will be on the list of interests.

materials containing at least 0.1% uranium or 3% thorium and are used for purposes of fission or breeding. All other materials are defined as radioactive materials.

As far as nuclear installations are concerned, the Nuclear Energy Act covers three distinct areas relating to the handling of fissionable materials and ores:

- (a) registration,
- (b) transport and management of such materials;
- (c) the operation of sites at which these materials are stored, used or processed.

Ad a) The registration of fissionable materials and ores is regulated in Sections 13 and 14 of the Nuclear Energy Act; further details are given in a special Decree issued on 8 October 1969 (Bulletin of Acts and Decrees 471). The statutory rules include a reporting requirement under which notice must be given of the presence of stocks of fissionable materials and ores. The Central Import and Export Office, part of the Tax and Customs Administration of the Ministry of Finance, is responsible for maintaining the register.

Ad b) A licence is required in order to transport, import, export, be in possession of or dispose of fissionable materials and ores. This is specified in Section 15a of the Act. The licensing requirements apply to each specific activity mentioned here.

Ad c) Licences are also required for construction, commissioning, operating, modifying or decommissioning nuclear installations (Section 15b), as well as for nuclear driven ships (Section 15c). To date, the latter category has not been of any practical significance.

Construction licences / operating licences / decommissioning licences

The Nuclear Energy Act distinguishes between construction licences and operating licences. In theory, a licence to build a plant may be issued separately from any licence to actually operate it. However, the construction of a nuclear power plant involves much more than simply building work. Account must be taken of all activities to be conducted in the plant. This means that the government needs to decide whether the location, design and construction of the plant are such as to afford sufficient protection from any danger, damage or nuisance associated with the activities that are to be conducted there. In practice, therefore, the procedure for issuing a licence to operate a NPP will be of limited scope, unless major differences have arisen between the beginning and the completion of construction work. For example, there may be a considerable difference between the Preliminary Safety Analysis Report (which provides the basis for the construction licence) and the Final Safety Analysis Report (for the operating licence). Views on matters of environmental protection may also have changed over the intervening period.

For decommissioning a licence is needed too.

Process and system for relicensing / licence renewal

Some changes in installations and procedures do not require a licence renewal, and others do.

In the case of minor modifications, a special provision in the Act (Article 17) applies that allows such modifications to be made with a minor licence change. This instrument can only be used if the consequences of the licence modification do not lead to different or greater environmental impact than under the current licence is permitted. The notification is published and is open to appeal. Furthermore, there may be licence conditions in the licence, that require the LH to present changes for verification to the RB. These are foreseen modifications within the scope of the licence that do not require an Article 17 notification. Also refer to section 4.1.c.1 on supervision.

With modifications that are not considered minor by the RB, licence renewal is needed. The LH will have to update its Safety Analysis Report and supporting documents and submit these to the RB for regulatory review. Under certain circumstances described in the annexes C and D of the EIA Decree, there is also an obligation to conduct an EIA. As with any licence application, public can express its views as is the case with 'normal' licence applications.

A special possibility for the Minister provided for by art 18a of the law, is to change the conditions in a licence because of numerous technical advances or new possibilities to protect the population that have become available since the original licence was issued.

19.1.c.2 Decrees, subordinate to the Nuclear Energy Act

A number of decrees and ordinances have also been issued, containing additional regulation and these continue to be updated in the light of ongoing developments. The most important of these in relation to the safety aspects of nuclear installations and radioactive materials include:

- the Radiation Protection Decree (Bs[11]).
- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse[12])
- the Transport of Fissionable Materials, Ores, and radioactive Substances Decree (Bvser[13]).
- the Radioactive Scrap Detection Decree[14]

The *Radiation protection decree* (Bs) regulates all general radiation protection issues for nuclear and non-nuclear installations, fissionable materials and radioactive materials, including the licensing. In this way the Bs regulates the protection of the public and workers against the hazards of all ionising radiation. The Bs establishes a licensing system for the use of radioactive materials and radiation emitting devices, and prescribes general rules for their use. For NORM this is further elaborated in the ordinance Natural Sources of Ionising Radiation (NABIS). This ordinance establishes a reporting system and protective measures for workers and environment. For high active sources, it is elaborated in the ordinance High-Activity Sealed Sources (HASS) and orphan sources. The ordinance (in compliance with Directive 2003/122/Euratom) establishes a registration system for high active sealed sources and ensures that LHs have financial provisions to cover treatment and disposal of used high-activity sources.

The *Nuclear Installations, Fissionable Materials and Ores Decree* Bkse, regulates all activities (including licensing) that involve fissionable materials and nuclear installations. According to its Article 6, applicants are required to supply the following information to the RB:

- a description of the site where the plant is to be located, including a statement of all relevant geographical, geological, climatological and other conditions;
- a description of the plant, including the equipment to be used in it, the mode of operation of the plant and the equipment, a list of the names of the suppliers of those components which have a bearing on the assessment of the safety aspects, and a specification of the plant's maximum thermal power;
- a statement of the chemical and physical condition, the shape, the content and the degree of enrichment of the fissionable materials which are to be used in the plant, specifying the maximum quantities of the various fissionable materials that will be present in the plant at any one time;
- a description of the way in which the applicant intends to dispose of the relevant fissionable materials after their use;

[11] Dutch: 'Besluit Stralingsbescherming', Bs

[12] Dutch: 'Besluit kerninstallaties, splijtstoffen en ertsen', Bkse

[13] Dutch: 'Besluit vervoer splijtstoffen, ertsen en radioactieve stoffen vervoer splijtstoffen, ertsen en radioactieve stoffen', Bvser

[14] Dutch: 'Besluit detectie radioactief besmet schroot'

- a description of the measures to be taken either by or on behalf of the applicant so as to prevent harm or detriment or to reduce the risk of harm or detriment, including measures to prevent any harm or detriment caused outside the plant during normal operation, and to prevent any harm or detriment arising from the Postulated Initiating Events (PIEs) referred to in the description, as well as a radiological accident analysis concerning the harm or detriment likely to be caused outside the installation as a result of those events (Safety Analysis Report);
- a risk analysis concerning the harm or detriment likely to be caused outside the installation as a result of severe accidents (Probabilistic Safety Analyses);
- a global description of plans for eventual decommissioning and its funding, in line with the recently established ordinance on shutdown and decommissioning.

The Transport of Fissionable Materials, Ores and Radioactive Substances Decree Bvser, deals with the import, export and inland transport of fissionable materials, ores and radioactive substances by means of a reporting and licensing system. The Radioactive Scrap Detection Decree stipulates that the larger metal recycling companies shall install detection portals to monitor scrap activity levels, and shall have financial reservations to cover possible undue responsibilities.

The Nuclear Energy Act and the above mentioned decrees are fully in compliance with the relevant Euratom Directive laying down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation and the Council Directive 2009/71/Euratom, establishing a Community framework for the nuclear safety of nuclear installations, and – at least partially – Council Directive 2011/70/Euratom, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste.

19.1.c.3 Environmental Protection Act (Wm[15])

The *Environmental Protection Act*, in conjunction with the Environmental Impact Assessment Decree, stipulates (in compliance with EU Council Directive 97/11/EC; see also the section on Article 8) that an Environmental Impact Assessment must be presented when an application is submitted for a licence for a nuclear installation.

In the case of non-nuclear installations, this act regulates all environmental issues (e.g. chemical substances, stench and noise); in the case of nuclear installations, the Nuclear Energy Act takes precedence and regulates both conventional and non-conventional environmental issues.

In compliance with the Environmental Protection Act and the Environmental Impact Assessment Decree, the licensing procedure for the construction of a nuclear installation (including a waste management facility) includes a requirement to draft an EIA. In certain circumstances, an EIA is also required if an existing plant is modified. More specifically, it is required in situations involving:

- a change in the type, quantity or enrichment of the fuel used;
- an increase in the release of radioactive effluents;
- an increase in the on-site storage of spent fuel;
- decommissioning;
- any change in the conceptual safety design of the plant that is not covered by the description of the design in the safety analysis report.

[15] Dutch: 'Wet milieubeheer', Wm

The Environmental Protection Act states that an independent Commission for Environmental Impact Assessments must be established and its advice can be sought whenever it is decided that an environmental impact assessment needs to be submitted by a person or body applying for a licence. The regulations based on this Act stipulate the type of activities for which such assessments are required.

The general public and interest groups often use the EIA as a means of commenting on and raising objections to decisions on nuclear activities. This clearly demonstrates the value of these documents in facilitating public debate and involvement.

19.1.c.4 General Administrative Act (Awb[16])

The *General Administrative Law Act* sets out the procedure for obtaining a licence, and also describes the role played by the general public in this procedure (i.e. objections and appeals).

Notice must be given, both in the Government Gazette and in the national and local press, of the publication of a draft decision to award a licence to a facility (e.g. for waste management). At the same time, copies of the draft decision and of the documents submitted by the applicant must be made available for inspection by the general public. All members of the public are free to lodge written objections to the draft decision and a hearing is to be held under the terms of the General Administrative Act. Any objections made to the draft version of the decision are taken into account in the final version. Anybody who has objected to the draft decision is free to appeal to the Council of State (the highest administrative court in the Netherlands) against the decision by which the licence is eventually granted, amended or withdrawn. If the appellant asks the court at the same time for provisional relief (i.e. a suspension of the licence), the Decree (i.e. the licence) will not take effect until the court has reached a decision on the request for suspension.

19.2 (i) National safety requirements and regulations for radiation safety

The regulatory framework has been described in the section on Article 19.1. This section details the requirements with respect to radiation safety.

a. General requirements

The Nuclear Energy Act (Kew), together with the Radiation Protection Decree (Bs), provides for a system of general goal oriented rules and regulations. The Bs also regulates general radioactive waste requirements, and prescribes that radioactive material for which no further use is foreseen can be declared as radioactive waste. Besides this, it stipulates that an authorized user of radioactive material is allowed to dispose of radioactive material without a licence in only a limited number of ways:

if not declared as waste:

- if the activity or the activity concentration is below the exemption/clearance levels, as applicable;
- in the case of sealed sources, if return of the source to the manufacturer or supplier of the source is possible;
- by transfer to another individual or legal person for use, reuse or recycling of this radioactive material or for collection and pre-treatment of radioactive waste, provided that this person holds a valid licence for this material;

if declared as waste:

[16] Dutch: 'Algemene wet bestuursrecht', Awb

- by transfer to a recognised waste management organisation. COVRA is the only recognized organisation for the collection, treatment and storage of radioactive waste[17];
- by transfer to another designated organisation for the collection of radioactive waste.

For all practical purposes, LHs for applications of radioactive materials are required to deliver their radioactive waste or fissionable materials for which no further use is foreseen or spent fuel which is not destined for reprocessing, to COVRA. The underlying philosophy is that, because of the relatively small amounts of waste to be managed, only a centralised approach can ensure an adequate level of professionalism in the management of the waste. Therefore most requirements are established in the licence of COVRA and few specific rules exist for spent fuel and radioactive waste management facilities.

b. Nuclear Safety Rules

The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse, Article 20) provides the basis for a system of more detailed safety regulations concerning the design, operation and quality assurance of nuclear facilities. These regulations are referred to as the Nuclear Safety Rules (NVRs[18]). The NVRs are based on the Requirements and Safety Guides in the IAEA Safety Standards Series. NVRs on design and operation of NPPs have been implemented in the licences (by referencing them in the licences) for the Borssele NPP, the research reactors and other nuclear facilities. This allows the RB to enforce the requirements of the NVRs. The RB uses the NVRs as the basis for review of the degree of compliance with the licence conditions by the operator.

c. Radiation Safety Requirements

The operations in the spent fuel and radioactive waste management facilities of COVRA are essentially governed by two Decrees for the safety aspects:

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse);
- the Radiation Protection Decree (Bs).

These Decrees set the criteria for:

- standard operation;
- design base accidents;
- incidents and accidents.

c.1 Standard operation

The Bs sets a maximum to the total individual dose of 1 mSv in any year for the consequences of normal operation of all sources emitting ionising radiation (i.e. NPPs, isotope laboratories, sealed sources, X-ray machines etc.), excluding natural background and medical exposures.

For a single source (for instance a waste management facility), the maximum individual dose has been set at 0.1 mSv per year.

An employer of a facility where workers can be exposed to ionising radiation is required to classify persons as radiation workers in one of the categories A or B. Category A workers are likely to receive doses greater than three-tenths of the dose limit (6 mSv per

[17] Decree on the designation of COVRA as recognized service for collection of radioactive waste, Bulletin of Acts and Decrees, 1987, 176. 4.Decree on the designation of COVRA as recognized service for collection of radioactive waste, Bulletin of Acts and Decrees, 1987, 176.

[18] Dutch: 'Nucleaire Veiligheidsregels', NVRs

year for whole body exposure). Category B workers are likely to be exposed during their work to radiation greater than the dose limit for the population at large (1 mSv per year for whole body exposure), but less than 6 mSv per year.

c.2 Design Base Accidents

The Bkse Decree specifies that the risks due to accidents for which protection is included in the design of the facility, i.e. the design base accidents, should be lower than the values given in Table 5.

Table 5 Set of safety criteria related to postulated Design Base Accidents for nuclear facilities

Frequency of occurrence (F)	*Maximum permissible effective dose (E, 50 years)*	
	Persons of age ≥ 16	Persons of age < 16
$F \geq 10^{-1}$	0.1 mSv	0.04 mSv
$10^{-1} > F \geq 10^{-2}$	1 mSv	0.4 mSv
$10^{-2} > F \geq 10^{-4}$	10 mSv	4 mSv
$F < 10^{-4}$	100 mSv	40 mSv

An additional limit of 500 mSv thyriod dose (H_{th}) must be observed in all cases. Non-compliance with the values in the table is a reason for refusing a licence.

c.3 Incidents and accidents

Bkse specifies probabilistic acceptance criteria for individual mortality risk and societal risk. The maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per annum for all sources together and 10^{-6} per annum for any single source. These numerical criteria were developed as part of general Dutch risk management policy in the late eighties. Based on an average annual mortality risk of 10^{-4} per annum for the least sensitive (highest life expectancy) population group (i.e. youngsters around 12 years old) from all causes, it was decided that any industrial activity should not add more than 1% to this risk. Hence, 10^{-6} per annum was selected as the maximum permissible additional risk per installation. Furthermore, it is assumed that nobody will be exposed to risk from more than 10 installations and the permissible cumulative individual mortality risk is therefore set at 10^{-5} per annum.

Where severe accidents are concerned, not only the individual mortality risk must be considered but also the group risk (societal risk). In order to avoid large-scale disruption to society, the probability of an accident in which at least 10 people suffer acute death is restricted to a level of 10^{-5} per year. If the number of fatalities increases by the factor of n, the probability should decrease by a factor of n^2. Acute death means death within a few weeks; long-term effects are not included in the group risk.

d. WENRA Reference levels

The Western European Nuclear Regulators' Association (WENRA) has introduced WENRA Reference Levels, aiming to harmonise reference levels for nuclear safety, the safe management of spent fuel, and radioactive waste and for decommissioning. In the framework of this Convention especially the WENRA reference levels for storage of radioactive waste and spent fuel and for decommissioning are relevant. The Netherlands participates in the WENRA Reactor Harmonisation Working Group and the Working Group on Waste and Decommissioning.

The Netherlands committed itself to implement the WENRA Safety Reference Levels (SRL) on waste and decommissioning in its legal system. The most relevant elements of the Dutch legal system are given by the Nuclear Energy Act, together with the Radiation Protection Decree (Bs), the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse), the Ordinance on implementation of the Nuclear Safety Directive and the

Ordinance on Decommissioning. The implementation of the SRLs into the Dutch legal system was benchmarked by the WENRA Working Group on Waste and Decommissioning for the first time at 2008. In 2012, the Netherlands reported its progress in the legal implementations. A number of SRLs were evaluated as not (completely) implemented in the national regulatory system. These SRLs will be implemented upon the establishment of regulation on Management and Organisation planned in 2016.

19.2 (ii) A system of licensing of spent fuel and radioactive waste management activities

Primarily responsible authority

The minister of Economic Affairs (EZ) is the primarily responsible authority for conducting the regulatory process under the Nuclear Energy Act (Kew) and for the main functions of the RB. For more information on ministerial responsibilities and organisation of the RB, refer to the text in the present report on Article 20 of the Convention.

In addition to the Nuclear Energy Act, several types of regulation may apply to a nuclear facility and the activities conducted in it and/or supporting it. Therefore often there are several authorities, sometimes at several levels in the governmental organisation involved in the licencing procedures.

For example, for the construction or major modification of a nuclear facility, a Building Permit is needed. This is governed by other non-nuclear laws and decrees, for which the local municipal authorities are the competent bodies.

The Nuclear Energy Act stipulates (in Article 15, sub b) that a licence must be obtained for construction, commissioning, operating, modifying or decommissioning a nuclear facility. Similarly, the Nuclear Energy Act also states (in Article 15, sub a) that a licence is required for importing, exporting, possessing and disposing of fissionable material.

Under Article 29 of the Nuclear Energy Act, a licence is required for the preparation, transport, possession, import and disposal of radioactive material in a number of cases that are identified in the Radiation Protection Decree.

The proper management of the (nuclear) licensing process is tasked to the Competent Regulatory Authority or 'Regulatory Body' (RB).

Procedures under the Awb

The procedures to obtain a licence under the Nuclear Energy Act (and other acts) follow the guidelines specified in the General Administrative Act (Awb). These procedures allow for public involvement in the licensing process. Any stakeholder is entitled to express his views regarding a proposed activity. If the Environmental Protection Act applies, everybody may express his or her view. The RB shall take notice of all views expressed and respond to them with careful reasoning. If a member of the public is not content with the reply, the RB can be challenged in court.

In the case of very minor modifications, the LH may make use of a special provision in the Act (Article 17) that allows such modifications to be made with a minor licence amendment. The LH needs to submit a report describing the intended modification. This instrument can only be used if the consequences of the modification for the public and the environment are within the limits of the licence in force. The notification is published and open to appeal.

Article 15b of the Nuclear Energy Act enumerates the interests for the protection of which a licence may be refused (listed above in the section on Article 19.1, sub c). The licence itself lists the restrictions and conditions imposed to take account of these interests. The licence conditions may include an obligation to satisfy further requirements, related to the subject of the licence condition, as set by the competent RB.

Environmental Impact Assessment, Safety Assessment, and processing comments of stakeholders

With a licence application, it very often is compulsory to conduct an Environmental Impact Assessment or EIA (Dutch: milieu-effectrapportage, m.e.r.). It is compulsory for all reactors with a thermal power higher than 1 kW. The Netherlands has a permanent commission, the Commission for the Environmental Assessment ('Commissie voor de m.e.r.', Cmer) that advises the RB on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear facilities.

The procedure EIA (chapter 7 of the Environmental Management Act) is:

- The initiator notifies the competent autority of his intention.
- The public can express its view on the scope of the envisaged EIA.
- An independent external committee advises on the content of the EIA for the initiative, taking into account the views of the public.
- The competent authority draws up a memorandum on the scope and the level of detail to be developed in the EIA, taking into account the views of the public.
- The initiator draws up the EIA.
- The independent external committee advices on the environmental report in relation to the memorandum on the scope and level of detail and the views of the public.

Prior to the application, the RB and the initiator enter into a stage of informal dialogue. During this stage, the concept for the application, the EIA if applicable, and the Safety Assessment Report are reviewed.

The initiator submits the application and the documents (including the EIA if applicable) and information pertaining to it. The RB assesses the application and draws up a draft decision. The public can express its views on the draft, and if applicable the EIA. Subsequently the RB draws up the final decision taking into account the submitted views. Finally, interested parties can lodge an appeal at the Administrative Law Judicial Division of the Council of State.

The RB will consider all views expressed by the public. When appropriate, it will group the views into a number of unique topics/views. The RB then will respond to all unique views and all responses are recorded with the documentation of the definite licence. Common responses of the RB include elaborations on policies, (assessment) techniques or other issues that need clarification.

Licence conditions

The national legislative framework provides the generic nuclear safety and radiation protection objectives that apply to all nuclear installations.

The Netherlands has a small nuclear programme. Nevertheless there are many different nuclear facilities and activities involving handling of radioactive wastes. Because of the diversity present, detailed requirements are listed in the licence requirements, tailored to the characteristics of the facilities and activities. In the licences, the Nuclear Safety Rules (NVRs) can be referred to as well as other nuclear codes and standards.

19.2 (iii) Prohibition to operate a facility without a licence

Article 15, paragraph b of the Nuclear Energy Act constitutes an absolute prohibition to construct, commission, operate, decommission or modify a nuclear facility, including a spent fuel or radioactive waste management facility, without a licence.

19.2 (iv) Institutional control, regulatory inspection and documentation and reporting

General

The constituent parts of the RB, which have a function in licensing and supervision of the different steps in spent fuel and radioactive waste management, are described in detail in the text under Article 20 of the Convention.

The licensing branch of the RB is responsible for assessing whether the radiological safety and security objectives in a licence application have been met. It should be noted that this branch is responsible for policymaking and licensing, and does not perform inspections. This branch has also responsibility for the implementation of international regulations and guidelines in the national legislation and for any other adjustments of the regulations deemed necessary.

Article 58 of the Nuclear Energy Act states that the Minister responsible for licensing procedures should entrust designated officials with the task of performing assessment, inspection and enforcement. The Decree on Supervision identifies the bodies that have responsibilities in this connection, being the inspectorate branch of the RB.

With regard to nuclear fuel cycle installations and NPPs in particular, almost all inspection tasks are carried out by the inspectorate, which possesses the technical expertise needed for the inspection of nuclear safety, radiation protection, security and safeguards. Further information is given in the section on Article 20 of the Convention.

Regulatory assessment

The regulatory assessment process is performed by the RB. For more information on the organisational structure and functioning of the RB, refer to the text in the present report on Article 20 of the Convention.

The licensing branch of the RB reviews and assesses the documentation submitted by the applicant. This may include the EIA Report and Safety Report with underlying safety analyses submitted within the context of a licence renewal or modification request, proposals for design changes, changes to Technical Specifications, et cetera.

Regulatory inspections

The inspectorate branch of the RB is responsible for supervision tasks. The function of regulatory inspections is:

- to check that the LH is acting in compliance with the regulations and conditions set out in the law, the licence, the safety analysis report, the Technical Specifications and any self-imposed requirements;
- to report any violation of the licence conditions and if necessary to initiate enforcement action;
- to check that the LH is conducting its activities in accordance with its QA system;
- to check that the LH is conducting its activities in accordance with the best technical means and/or accepted industry standards.

All inspections with regard to nuclear safety, nuclear security, radiological protection of personnel and of the environment around nuclear sites, security and safeguards, including transportation of fresh and spent nuclear fuel and related radioactive waste to and from nuclear installations are carried out by the inspectorate branche of the RB.

To check that the LH is acting in compliance with the Nuclear Energy Act, the licence and the associated Safety Analysis Report (SAR), there is a system of inspections, audits, assessment of operational reports, and evaluation of operational occurrences and incidents. Inspection activities are supplemented by international missions. An important piece of information for inspection is the safety evaluation report, conducted at 2-5 years periods. In this report the LH presents its self-assessment of all the relevant technical, organisational, personnel and administrative matters.

Every ten years a major assessment of the accomplishments in the area of safety and radiation protection is performed by the staff of the spent fuel and radioactive waste management facility and compared with new developments.

The management of inspection is supported by a yearly planning, the reporting of the inspections and the follow-up actions. On an annual or quarterly basis, dependent on the type of facility, a meeting between facility management and inspectorate management is held devoted to inspections and inspection findings, during which any necessary remedial actions are established and the progress made with their execution discussed.

19.2 (v) The enforcement of applicable regulations and of the terms of the licences

As indicated in the section on Article 19.2 (iv), there is a Decree on Supervision on Inspection and Enforcement of the Nuclear Energy Act. This deals with the inspection and enforcement of the regulations and the terms of licences. An extended series of articles has been published covering all aspects for which supervision is required, from public health to security and financial liability. The Decree also specifies the responsible authorities.

Should there be any serious shortcoming in the actual operation of a nuclear installation, the Ministers of EZ and SZW are empowered under Article 37b of the Nuclear Energy Act to take all such measures as deemed necessary. Written enforcement procedures have been published describing the action to be taken if this article of the Act needs to be applied. Special investigators have been appointed to prepare an official report for the public prosecutor, should the need occur.

Article 19.1 of the Nuclear Energy Act empowers the RB to modify, add or revoke restrictions and conditions in the licence in order to protect the interests on which the licence is based. Article 20a of the Act designates the authority that is empowered to withdraw the licence, if this is required in order to protect these interests.

Article 15aa of the Nuclear Energy Act empowers the RB to force the LH to co-operate in a process of total revision and update of the licence. This action is indicated if for instance comprehensive modifications are proposed or when after a number of years the licence is less clear (or outdated) due to a large number of changes during that time.

19.2 (vi) A clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management

The constituent parts of the RB, which have a function in licensing and supervision of the different steps in spent fuel and radioactive waste management, are described in the text under Article 20 of the Convention.

Furthermore, most of the waste management activities have been centralised in one waste management organisation, the COVRA. Most of the radioactive wastes is collected and managed in COVRA's facilities. Furthermore COVRA manages a national research programme on radioactive waste (OPERA). In addition COVRA manages the waste management fund, that eventually will provide the financing of a geological disposal.

Having a single organisation (COVRA) taking care of all the steps in the management of radioactive wastes, aids the efficient execution of the interdependent steps of the radioactive waste management process.

19.3 Regulation of radioactive materials as radioactive waste

The radioactive waste policy follows closely the approach chosen for the management of conventional waste. Conventional waste is considered to include other hazardous waste, but also household refuse. This approach is based on the following series of hierarchical principles:

- In principle, the generation of waste is undesirable from the point of view of sustainable development (integrated life-cycle management). Waste is the result of an imperfect utilization of materials in the networks of interconnected processes. Consequently, the generation of waste should be prevented. Realising that most processes have already been optimised in previous decades, although often for economic reasons and as individual processes, it is more realistic to state that generation of waste should be minimised. As radioactive waste is concerned, the Radiation Protection Decree requires the holder of a licence for radioactive materials to minimize the generation of radioactive waste as far as reasonably possible. The preferred use of radioactive materials with short decay-times fits within this policy.
- If it is not possible to further reduce the amount of waste in a process, attempts should be directed to return the waste into the process by product reuse or by materials reuse (recycling). In the case of radioactive materials, the Radiation Protection Decree stipulates that the holder of a licence for radioactive material shall reuse sources, or materials of these sources.
- If reuse or recycling cannot be achieved, or if it can only be achieved under adverse environmental conditions, incineration should be considered in order to benefit from the heat of the combustion process (recovery).
- Disposal is the last resort in case all previous options have been exhausted. For highly toxic waste such as high-level radioactive waste it is advocated that such waste be stored until more advanced processing technologies become available. In the case of radioactive waste, the Netherlands has adopted a policy based on centralised pre-disposal storage for a period of at least 100 years at COVRA. All associated costs are born by the generators of the waste. Recently, a requirement was added to the Bkse-decree making the generator of the waste formally responsible to arrange sufficient storage capacity at COVRA, which in practice means that the generator of the waste will have to pay COVRA for creating storage capacity.
- Long-term disposal must be arranged for existing waste and for future waste if arising of this waste cannot be prevented. The disposal facility should be constructed in such a way that the waste is not only retrievable but that in principle the whole disposal process can be reversed. This requirement is imposed firstly with the aim to maintain control over the waste and secondly to ensure that the waste remains accessible for purposes of re-entering it into the cycle when such an opportunity arises provided that this can be done in an environmentally responsible manner.

By adhering to these principles, and thus minimising the amount of waste while ensuring that the waste which cannot be processed, is managed in an environmentally sound way the objectives of this Convention are complied with.

Furthermore the Netherlands has interpreted the scope of this Convention in the most extensive manner by declaring waste containing natural radionuclides to fall under the requirements of the Convention. Doing this ensures that these wastes are managed properly, with due respect to the potential hazards that such waste can pose to exposed groups of persons.

Article 20. REGULATORY BODY

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

2. Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation.

20.1 Regulatory Body - regulatory and organisational framework

For information on the legislative system and the system of licensing, refer to the information provided under Article 19 of the Convention in the present report.

20.1.a Ministerial responsibilities

The minister of Economic Affairs (EZ) is the primarily responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the RB.

Several other ministers also have responsibilities in specific areas related to the use of radioactivity and radiation. The ministry of EZ is the coordinating ministry for all the issues related to the Nuclear Energy Act. The following list illustrates the responsibilities of the various ministers regarding the various areas of interest:

- Minister of Economic Affairs (EZ) for nuclear safety, radiation protection, physical protection of fissile materials and radioactive materials and wastes. Also coordinating minister for the Act; i.e. minister reporting to Parliament and responsible for the 'maintenance' of the Act. The coordination function has been recorded in a special Decree.
- Minister of Economic Affairs (EZ) for radiation protection in the mining industry.
- Minister of Social Affairs and Employment (SZW) for worker safety and health.
- Minister of Health, Welfare and Sports (VWS) for healthcare and patient safety.
- Minister of Infrastructure and the Environment (I&M) for non-radiological emissions into surface water.
- Minister of Security and Justice cooperating in the execution of the National crisis response plan radiological incidents (NCS).
- Minister of Defence for applications of ionizing radiation by the military.
- Minister of Finance for liability issues, including nuclear accidents.
- Minister of Foreign Affairs for the coordination of Dutch foreign policy, regarding to the Nuclear Energy Act especially focused on non proliferation and Euratom and IAEA affairs.

20.1.b Regulatory Body

Organisation

For the purpose of this report, the 'Regulatory Body' (RB) is the authority designated by the government as having legal authority for conducting the regulatory process, including issuing authorizations, supervision and enforcement and thereby regulating nuclear safety, radiation protection, radioactive waste management and transport safety.

The separate entities of the RB currently reside in several ministries, but a major reorganisation is ongoing, establishing one single new RB. For more information on the pending reorganisation, please refer to the Introduction of the present report.

The separate entities of the RB operate with working agreements under the responsibility of the minister of EZ. Their responsibilities and tasks are summarized below:

- Within the ministry of EZ, the 'programmadirectie voor Nucleaire Installaties en Veiligheid' (pdNIV), i.e. Nuclear Installations and Nuclear Safety Directorate, is responsible for the preparation of legislation, formulating policies (excluding energy policy), regulatory requirements, licensing and related review and assessment.
- Within the ministry of EZ, the 'Rijksdienst voor Ondernemers' (RvO), team Radiation Protection & Society[19] has been mandated to grant licences under the Nuclear Energy Act, excluding licences for nuclear installations and licences for the larger transports of nuclear fuel. Such licences are issued by the pdNIV.
- The nuclear inspectorate of the RB, the 'Kernfysische dienst' (KFD) is within the general responsibility of the Minister of EZ the organisation responsible for the independent supervision (safety assessment, inspection and enforcement) of compliance by the LHs with the requirements on the safety, security and non-proliferation[20]. The KFD is embedded in an organisational division of the Human Environment and Transport Inspectorate (ILT) of the ministry of Infrastructure and the Environment (I&M).
- It should be noted that in addition to the KFD, there are other inspectorates contributing in a limited way to the supervision of the activities of the LHs.

Each of the entities pdNIV, RVO and KFD has its own set of responsibilities and tasks, related to the Nuclear Energy Act. Nevertheless, there are many projects of the RB in which the entities work together in projecteams. Examples are the National Report for the European stress test and associated Peer Review, the National Report to the Convention on Nuclear Safety and associated activities, the present national report for the Joint Convention, and the upcoming IRRS mission and its preparation.

Responsibilities for safety of SF management and radioactive management facilities

Prime responsibility for nuclear safety of a nuclear facility rests with the LH. This responsibility cannot be delegated.The Netherlands have implemented European Council directive 2009/71/EURATOM. While not explicitly mentioned in the regulation that implements the Directive, the responsibility of the LH stems from the systematics of the Dutch legal system including the Nuclear Energy Act and subordinate regulation, and the duties of the LH described therein.

The ultimate responsibility for management of the spent fuel and radioactive waste generated in them, including to establish and maintain national policies and frameworks, and to assure the needed resources and transparency in the European Union rests with its Member States. The Netherlands have implemented European Council Directive 2011/70/EURATOM. This Directive requires the allocation of responsibility to the bodies involved in the different steps of spent fuel and radioactive waste management. In particular, the national framework shall give primary responsibility for the spent fuel and radioactive waste to their generators or, under specific circumstances, to a LH to whom this responsibility has been entrusted by competent bodies.

[19] Dutch: 'Team stralingsbescherming en samenleving'

[20] These requirements apply to activities and facilities (including nuclear facilities).

Implementation of the national safety framework by the RB and other organisations

Nuclear facilities operate under licence, awarded after a safety assessment has been carried out. The licence is granted by the RB under the Nuclear Energy Act. The licensing branch (pdNIV) is responsible for handling the licence applications and performing related review and assessment.

The inspectorate branch KFD is responsible for review and assessment activities in relation with its oversight activities.

Both pdNIV and KFD may seek expertise by contracting expertise from TSOs and other national and/or foreign expert organisations; this is a common practice.

Expertise and skills in nuclear safety & radiation protection at the RB

The expertise of the RB spans disciplines such as radiation protection, waste management, nuclear safety, risk assessment, security and safeguards, emergency preparedness, legal and licensing aspects.

The RB provides tailor-made training for its staff.

Apart from the general courses, training dedicated to the technical discipline is provided. This includes international workshops, but also conferences and visits to other regulatory bodies. In addition there is information exchange through the international networks of OECD/NEA, IAEA, EU etc. To be mentioned are the contributions to WENRA, ENSREG, WASSC, TRANSSC, NUSSC, RASSC, NERS, NEA/CNRA and several of its Working Groups.

Experts have to keep up to date with developments in their discipline and are also responsible for maintaining a network for a number of other disciplines that are not permanently available. It is the policy of the RB that the core experts have sufficient knowledge to specify and assess work done by external experts.

For areas in which its competence is not sufficient or where a specific in-depth analysis is needed, the RB has a budget at its disposal for contracting external specialists. This is considered one of the basic policies of the RB: the core disciplines should be available in-house, while the remaining work is subcontracted to third parties or Technical Support Organisations (TSOs).

20.2 Independence of regulatory functions

Independence in decision making

The RB is not in any way involved in energy policies. The different entities forming the RB are effectively separate from other bodies dealing with energy policies. The RB's involvement with nuclear power is restricted to nuclear safety and radiation protection and associated security issues. The entities of the RB that are embedded in organisational divisions of the ministry of Economic Affairs (pdNIV and RVO), are kept separate from divisions associated with energy policies. The inspectorate branche of the RB is part of another ministry but operates under the responsibilty of the Minister of Economic Affairs, who also determines its budget.

The RB is also separate from bodies or organisations involved in production and application of radioisotopes, and organisations involved in the management of spent fuel and/or radioactive waste.

COVRA is an independent company (state-owned enterprise) responsible for the safe management of SF and radioactive waste and for implementing a part of the policy of the Netherlands on the safe management of radioactive waste and SF. As a LH, COVRA is subject to regulatory oversight by the RB.

Decisions are taken by the RB independently from energy policy and LHs. The RB is transparent in its decision making. The reporting arrangements (described below) are instrumental in achieving perception of independence in decision making.

Reporting arrangements

The different entities forming the RB report to the minister of Economic Affairs (EZ) being the primarily responsible authority for conducting the regulatory process under the Nuclear Energy Act. The minister of EZ reports regularly to Parliament on nuclear safety, radiation protection, and other Nuclear Energy Act issues. Results of major studies, conducted under the authority of the RB are presented by the minister of EZ to Parliament. In addition, Parliament can require the minister to report to Parliament on specific issues.

Every year the Human Environment and Transport Inspectorate (ILT) prepares a report about its inspection activities, including those of its subdepartment the KFD. This publication is made available to the public on the I&M[21] ministry's website. In addition KFD prepares an annual report on nuclear incidents to be sent to the Dutch Parliament. KFD is also further developing its own part of the ILT-website.

The ministry of EZ has extensive dossiers on many issues published on its website, featuring many in-depth studies on issues related to nuclear-related activities. Information on all major LHs can be found online too. This is part of the ministry's policy on transparent governance.

Also, the licensing procedures provide for timely publication of documents. The General Administrative Act (Awb) is the body of law that governs the activities of administrative agencies of government and the interaction of the public in the procedures (i.e. objections and appeals).

Information to the public

The Dutch regulations satisfy COUNCIL DIRECTIVE 2011/70/EURATOM establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste. Article 10 of the Directive states the requirements regarding 'transparency'. This does include the provision of information to public and workers, but also the necessary opportunities for the public to participate effectively in the decision making process regarding SF and radioactive waste management in accordance with national legislation and international obligations.

The different entities of the RB such as EZ/pdNIV and KFD have strategies for external communication which broadly follow the ENSREG guidance on communication strategies. However, in preparing for the new organisation that will bring together the various entities of the RB, a new integrated strategy will be developed.

The General Administrative Act (Awb) is the body of law that governs the activities of administrative agencies of government and the interaction of the public in the procedures (i.e. objections and appeals). The Awb applies to virtually all procedures under any law. The Awb also provides for procedures regarding publication of information of draft decisions, like those to award a licence. These need to be published in the Government Gazette, and in the national and local press. Under the Awb, documents provided with an application for a licence are to be made available for inspection by members of the public. All members of the public are free to lodge written opinions on the draft decision and to ask for a hearing.

Specific requirements for the publication of new regulations are also laid down in the Publication Act (Bekendmakingswet). All new legislation is published on the Internet[22] and in the Government Gazette after enactment by the parliament.

Beyond this, ministries may make their own arrangements to provide greater accessibility to their regulations. Announcements of new regulations have to be published in the "Staatscourant".

[21] Dutch: 'Infrastructuur & Milieu', i.e. Infrastructure & Environment
[22] www.overheid.nl

Under the Dutch Government Information (Public Access) Act (Wob), as a basic principle, information held by public authorities is public, excluding information covered by the exceptions enumerated in the Act in its Article 10. The act requires authorities to provide information unsolicited as it is in the interest of good and democratic governance, without prejudice to provisions laid down in other statutes. According to Article 3 of the Wob, any person can request information related to an administrative matter as contained in documents held by public authorities or companies carrying out work for a public authority.

The Nuclear Energy Act states requirements regarding providing information to the public in case of accidents and to staff mitigating the consequences of such accidents. Stakeholder involvement is embedded by public consultation during the licencing process under the General Administrative Act (Awb) and if applicable in the process of the Environmental Impact Assessment (EIA) under the Environmental Protection Act. This process also involves meetings of RB, LH and the public. The RB is transparent in its communication of regulatory decisions to the public (e.g. on licence applications and adequacy of 'stress tests'); these are published with supporting documentation.

Section F Other General Safety Provisions

Article 21. RESPONSIBILITY OF THE LICENCE HOLDER

1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

2. If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.

21.1 Prime responsibility for Safety

Several legal provisions ensure that the LH is primarily responsible for the safety of the management of radioactive waste and spent fuel.

The Nuclear Energy Act (Articles 15 and 29) forbids practices with radioactive materials (including radioactive waste and spent fuel) without a proper licence. During the licence application procedure the prospective LH has to present, inter alia, a safety case, which shall be assessed by the RB. Once the licence is issued, the LH is charged with the prime responsibility for compliance with the licence and licence requirements. Besides this, a number of general requirements apply for LHs.

Regarding the operation or decommissioning of a nuclear facility, a similar reasoning applies, based on Article 15b of the Nuclear Energy Act. This licence covers both the safety of the facility as well as the safety of the waste or spent fuel.

At the moment radioactive material is classified as waste, a number of additional requirements apply. The most important requirement is that the waste shall be transferred to COVRA as soon as reasonably possible. Some exeptions to this rule can be found in section 32.1(iv) of the present report. Upon transferral of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA.

21.2 Responsibility of Contracting Party if there is no licence holder or other responsible party

In Articles 22 and 33 of the Nuclear Energy Act provisions have been made for situations where the owner or other responsible person or organisation of fissionable material (including spent fuel) or radioactive material respectively cannot be identified. This applies for example to orphan sources. In such cases the inspectorate branch of the RB (the KFD) has been empowered to impound such material and have it transferred it to designated institutes, which are equipped and licensed to manage these materials.

The institutes which have been designated by a special decree[23] are: NRG[24] in Petten and COVRA in Borsele for fissionable materials. The same institutes as well as the RIVM in Bilthoven have also been designated for radioactive materials.

[23] Decree on the designation of institutes as meant under articles 22 sub 4 and 33 sub 4 of the Nuclear Energy Act, Bulletin of Acts and Decrees 1996, 528

[24] Nuclear Research & consultancy Group, NRG

Article 22. HUMAN AND FINANCIAL RESOURCES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;

(ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning;

(iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

22 (i) Qualified Staff

The Nuclear Energy Act requires that an application for a licence for a nuclear facility shall contain an estimate of the total number of employees plus details of their tasks and responsibilities and, where applicable, their qualifications. This includes supervisory staff. The LH has to submit its education and training plan for the RB's information and approval. These requirements apply also to the COVRA waste and spent fuel management facilities.

COVRA has implemented a Personnel Qualification Plan (as part of a more generic quality management system) in which clear details of the responsibilities, authority interfaces and lines of communication, requisite level of expertise, and the requirements for training and education are laid down. A training plan ensures that an adequate number of staff, with relevant expertise and appropriately trained is always available. Any major organisational changes, e.g. at management level, must be reported to the authorities.

22 (ii) Adequate financial resources

One of the basic principles governing radioactive waste management and also adhered to in the Netherlands is *the polluter pays principle*. This principle requires that all costs associated with radioactive waste management are borne by the organisations or institutes responsible for the generation of this waste.

As regards the management of spent fuel and other high-level waste, the utilities and the operators of research reactors agreed to jointly build a facility for treatment and long-term storage of SF and HLW at the COVRA site. This building (HABOG) was commissioned in 2003 and is now receiving vitrified and other high-level waste from reprocessing plants as well as spent fuel and other high-level waste from the research reactors. Both the construction costs and the operating costs are borne by the generators of the spent fuel and the high-level waste.

In the frame of transfer of ownership of COVRA from the utilities and ECN to the State, the utilities decided to discharge themselves from any further responsibility for management of the radioactive waste. They made a down payment to COVRA covering the discounted costs for operation and maintenance of the HABOG during the envisaged operational period (~100 years). The other customers of the HABOG pay their share of operational costs by annual instalments.

For LILW there are fixed tariffs for specified categories of radioactive waste which take into account all management costs including disposal after some 100 years of interim storage. Once the transfer of the waste has been accomplished the customer is exempted from further responsibility for the waste. No surcharges can be made to make up for exploitation losses by COVRA and no waste can be returned to the customers.

While the tariffs are annually adjusted with the price index, every five years the tariff structure is evaluated with the aim to reconsider the need for any structural adjustment. However, the utmost restraint is exercised to any proposal for an increase of the tariffs, in order to prevent the temptation of environmentally irresponsible behaviour with the waste by the customer. In the previous period COVRA suffered substantial and structural exploitation losses for the management of LILW which can be partly attributed to a successful implementation of national waste separation and reduction policies. Financial support as a combination of a subsidy and a loan was granted by the government, aimed to ensure that COVRA will have a neutral financial result over the period up to and including 2015. In 2012, the loan was converted into a targeted subsidy for the waste treatment building (AVG).

In 1986 a study was conducted with the aim to estimate the costs for the construction and operation of a repository for radioactive waste in salt formations in the deep underground. It is envisaged that all radioactive waste, LILW and HLW, will be placed in this repository. The total cost was estimated at 1230 Meur of which 820 Meur for the disposal of HLW (1986 price level). These cost estimates formed the basis for the establishment of financial provisions by the operators of nuclear facilities and have been taken into account in the calculation of the discounted costs as mentioned before. A real interest rate of 3.5% and a discounting period of 130 years were used in the calculations for disposal of HLW. This sum was disbursed to COVRA in the framework of the transfer of ownership of COVRA to the State and put in a separate fund which is managed by COVRA. The money is stored at an account at the Ministry of Finance and guaranteed by the state. Every 5 years since, the basis for the cost estimate has been re-assessed. In case of inadequate fund growth the fees for waste are adjusted.

For LILW a separate procedure is followed: COVRA raises a surcharge for waste disposal on the fees of generators of radioactive waste. This sum is added to the fund. Out of the total amount of money estimated to be needed for the construction and operation of a disposal facility, one third has to be covered by the surcharge on LILW. The other part has to be covered by the HLW and SF.

The adequacy of financial resources for decommissioning is addressed under Article 26 of the Convention.

22 (iii) Institutional controls

The national disposal research programme OPERA (see section B of the present report) addresses the issue of institutional controls and makes proposals on the types of institutional control necessary, taking into account the prolonged retrievability of the waste from the repository. It is, however, not expected that the recommended institutional controls will lead to significantly different cost estimates.

Article 23. QUALITY ASSURANCE Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

23 Quality Assurance

General

Due to the limited size of the nuclear industry, it was not cost-effective to develop a specific national programme of QA rules and guidelines. As a result, initially the IAEA SS QA Series No. 50-C-Q was chosen to provide the basis for the QA programme in the Netherlands. The No. 50-C-Q has been replaced by IAEA GS-R-3 "The management system for facilities and activities". The implementation of GS-R-3 has been completed at the NPP Borssele and at COVRA this process is well underway and will be concluded in 2015. It is anticipated the GS-R-3 will be replaced by another IAEA guide, considering the development of the (still draft) DS-456 guide.

At COVRA, provisions from the industrial standards NEN-ISO 9000 – 9004 have also been implemented.

The RB is in the process of drafting a requirements document on Management and Organisation, which is based on DS-456 and SSR 2/2. It is expected to be published and implemented in 2016.

Regulations

The Integrated Management System (IMS) of COVRA is part of the operating licence and hence is binding for the LH. Those parts of the IMS that apply specifically to design and construction of the installations and to the safe operation of the spent fuel and waste management facilities require prior approval from the KFD.

Specific elements of the IMS of COVRA

The core of the system is the Integrated Management System Manual. This IMS Manual contains:

- Policy statements;
- The values and expectations of senior management;
- A description of the structure of the organization;
- A description on how the management system complies with the requirements imposed on the organization;
- A description of the processes as well as supporting information that explain how work is to be prepared, reviewed, carried out, recorded, assessed and improved.

With regard to the acceptance criteria for vitrified waste it is worth to mention that the specifications were drawn by the reprocessing facilities and approved by the operators of the NPPs and the RB. These specifications were used – among other things – as input for design and licensing of COVRA's HLW facility. These specifications include guaranteed parameters for contamination and radiation levels, heat load and chemical composition. Before shipment from the reprocessing site to COVRA, all relevant data and product files are provided and checked, compliance with transport regulation is assured, and the canisters are witnessed by COVRA and the NPP operator. Upon arrival at the COVRA site a second check is performed.

Article 24. OPERATIONAL RADIATION PROTECTION

1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility:

(i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;

(ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection;

(iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.

2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:

(i) to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and

(ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.

3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

24.1 (i) ALARA

As has been stated before in the text on Article 19 of the Convention, the basic legislation on nuclear activities in the Netherlands is the Nuclear Energy Act. A number of decrees have also been issued, containing more detailed regulations based on the provisions of the Act. The most important decrees for the safety aspects of nuclear facilities and the radiation protection of the workers and the public are:

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse);
- the Radiation Protection Decree (Bs).

The Bkse requires the LH of a nuclear facility to take adequate measures for the protection of people, animals, plants and property. Article 31 of the Bkse states that a licence must contain requirements aimed at preventing the exposure and contamination of people, animals, plants and property as far as possible. If exposure or contamination is unavoidable, the level must be as low as is reasonably achievable (ALARA). The number of people exposed must be limited as much as possible, and the LH must act in accordance with the individual effective dose limits.

The Bs states that these activities must be carried out by or under the responsibility of a person with sufficient expertise, subject to the judgement of the RB. This expert should occupy a post in the organisation such that he or she is able to advise the management of the facility in an adequate way and to intervene directly if he or she considers this to be necessary.

Written procedures must be available to ensure that the radiological protection measures which have to be taken are effective and that the above-mentioned expert is properly informed. Full details of these conditions are given in the Bs, which also lays down more specific requirements on the protection of people and the environment from radiation. Throughout the Bs the concept of ALARA is used and it is required to be applied to all exposures and discharges as well as to disposal of radioactive waste.

The above requirements also apply for the holder of a licence for practices with radioactive materials.

24.1 (ii) Dose limits

Protection of the workers

In conformity with the Euratom Basic Safety Standards the aforementioned Radiation Protection Decree (Bs) stipulates a limit of 20 mSv per year as the maximum individual effective dose for radiation workers.

An employer of a spent fuel or a radioactive waste facility is required to classify persons as radiation worker in one of the categories A or B. Category A workers are likely to receive doses greater than three-tenths of the dose limit (6 mSv per year for whole body exposure). Category B workers are likely to be exposed during their work to radiation greater than the dose limit for the population at large (1 mSv per year for whole body exposure), but less than 6 mSv per year.

Article 90 of the Bs requires that the employer records doses incurred by each exposed employee using personal dosimetry. As regards personal dosimetry no distinction is made between Category A and B workers. Only approved dosimetry services are allowed to provide dosimeters, to assess the received dose and to manage the dose records of exposed individuals.

Dose summaries of all dosimetry services are made available to the National Dose Registration and Information System (NDRIS). NDRIS has been established in 1989 by the Ministry of Social Affairs and Employment and had as main objective to preserve dosimetric data for the period required by the Euratom Basic Safety Standards as well as to bring together all data from all registered radiation workers, including those of foreign workers from abroad whose data are identified through the radiation passport.

Apart from a valid radiation passport, no special work permits are necessary for radiation workers. According to the directive 90/641/Euratom, Dutch legislation obliges a LH who hires a radiological worker to ask for the radiation passport, and to respect the annual dose constraints of 20 mSv for A workers and 6 mSv for B workers. The KFD is responsible for surveillance. There are no special ALARA review programmes for workers expected to exceed the 6 mSv dose constraint. However, some LHs have the policy not to hire workers with more than 10 mSv in their radiological passport. In practice, the number of workers with a dose higher than 5 mSv is very low.

Management of NDRIS

NDRIS is managed by NRG. In the beginning only data from individuals employed at institutes which had subscribed to the dosimetric services of NRG were collected and gradually also from the other approved dosimetric services. In 1994 and 2002 respectively, NDRIS was extended with data from external workers and with data from aircraft crew. NDRIS generates statistical data with the following features:

- personal data
- social security number
- dosimetric data

- branch of industry (e.g. hospitals, nuclear industry)
- job category (e.g. veterinary X-ray diagnostics, radioactive waste treatment)

NDRIS is designed to process the collected data, to make statistical analyses of the recorded doses and to present various cross-sections for management purposes. It enables employers to collate information on occupational doses and to optimize operational radiation protection. To date, NDRIS shows the occupational exposure to radiation is low.

Radiation protection at COVRA

The LH of the COVRA facility has taken measures to ensure that radiation doses for the exposed workers remain well under the dose limit. The design of the installations and the work procedures are aimed to maintain a dose constraint of 6 mSv for the individual dose. In 2013 the highest individual dose recorded for the 46 radiation workers was 1.65 mSv. The collective dose for these persons was about 29 millimanSv in the same year. In the last decade the occupational exposures have shown little variance from the values mentioned.

In order to comply with the set targets, the outside area, the buildings and the working spaces are divided in three colour-marked zones according to the scheme in Table 6. The white zone comprises the non-controlled area. For purposes of radiation protection there are no access restrictions. Under normal circumstances there is no contamination with radioactivity in this zone. If it occurs anyway it is due to an incident and consequently temporary in nature. In this case access restrictions apply until the contamination has been removed and the area has been cleared by the Radiation Protection Department. Radiation levels can be enhanced temporarily in the neighbourhood of vehicles carrying radioactive cargo. The green and red zones constitute the guarded and controlled zones. These zones are situated exclusively within buildings and are not accessible without permission of the Radiation Protection Department. In the green zone the length of stay for radiation workers is unlimited. The working procedures for the other zones are laid down in written instructions.

Table 6 Operational zones used to control individual exposures

Zone	*Dosimeter mandatory*	*Radiation level (mSv/h)*	*And/or*	*Contamination level (Bq/cm2)*	
White	no	< 0.0025	and	α	≤ 0.04 and
				β,γ	≤ 0.4
Green	yes	≤ 0.025	and	α	≤ 0.4 and
				β,γ	≤ 4
Red	yes	> 0.025	and/or	α	> 4 and/or
				β,γ	> 40

Protection of the public

In article 48 of the Bs a source limit amounting to one tenth of the annual effective dose limit for the public (1 mSv) has been set for any practice or facility, to be measured or calculated at the border of the facility. The reason for this is that an individual LH cannot be held responsible for the exposure caused by other practices or facilities. Therefore, a tenth of the cumulative dose limit of 1 mSv is allocated to every individual LH as a source limit. This is based on the assumption that, by applying these source limits, it is very unlikely that for an individual member of the public the 1 mSv limit will be exceeded to exposure by all sources together in a single year.

At specific locations at the site boundaries of COVRA thermo luminescent detectors are installed that are read out every quarter year. The results of these measurements are corrected for background radiation (measured elsewhere on the site) and multiplied by the fixed factor related to the maximum period of time any person might conceivably be present at the site boundary

At COVRA the equivalent dose rate at the boundaries of the establishment is as low as reasonably achievable (ALARA), but not higher than a fraction of the dose limit for the public. Both the LH (COVRA) and an independent institute (RIVM) monitor the radiation levels at the border of the establishment continuously. In 2013 the highest ambient dose measured at any point at the fence was below 0.28 mSv/y. This is approximately two-third of the limit accorded to COVRA in the operating licence.

24.1 (iii) Measures to prevent unplanned and uncontrolled releases of radioactive materials into the environment

The buildings and installations of the waste storage facility of COVRA are designed to retain their integrity or at least to limit the consequences should an unplanned event occur. For the purpose of a consequence analysis, events have been divided into four different categories:

- Category 1. Standard operation
- Category 2. Incidents
  This category describes events, having an irregular frequency of occurrence (about once a year) such as failure of the electrical supply for a short period;
- Category 3. Accidents
  In this category all accidents are included which could occur during the operational life of the facility, such as a fire in the installations, a drop of a package with radioactive contents, or failure of the electrical supply during substantial periods. The frequency of occurrence is in the range of 10^{-1} to 10^{-2} per annum.
- Category 4. Extreme accidents
  These are accidents which, without mitigating measures, could have an impact on the environment. Some of these events have been taken into consideration in the design of the buildings and of the installations. The frequency of occurrence is in the range of 10^{-2} to 10^{-6} per annum

External events from category 4 which have been considered in the consequence analysis are the following:

- Flooding of the buildings
- Earthquakes
- Hurricanes
- Gas cloud explosions
- Release of toxic and/or corrosive substances
- Crashing aircraft (military aircraft)
- External fire

Only the storage building for HLW (HABOG) has been designed to withstand the events mentioned before.

Accidents of lower frequency of occurrence such as a crash of an aircraft with higher speed and greater mass than the one used in the design base accident have also been considered. However it was concluded that the risk is so low that modification of the design was not justified.

The consequences of the design base accidents of category 4 for the HABOG have also been assessed for the other buildings (treatment and storage buildings for LILW) and have been found to be acceptable: for each accident scenario the risk was lower than 10^{-8} per year. Also the cumulative risk was found to be lower than 10^{-8} per year. Internal fires in the treatment facility for LILW constitute the accident scenario with relatively the highest risk.

Severe accidents initiated by outside events have been considered as beyond design base accidents. These initiating events are the same as mentioned for COVRA. It has been shown that the chance of incurring fatal radiation injury for any individual outside the perimeter fence from any of these events is smaller than 10^{-8} per year. The risk is not determined by the presence of spent fuel, but by the shorter-lived fission products produced by the working reactor.

24.2 Radioactive discharges

Discharges from COVRA

Both atmospheric and liquid discharges of radionuclides are restricted by requirements in the operating licence of COVRA. In Table 7 the annual discharge limits for different categories of radionuclides are represented. For the derivation of the authorized discharge limits the annual dose limits for the population are the determining factor. In the second place a source limit of one tenth of the annual dose limit will be applied to a single facility. In the third place the operator is required to make a proposal for the discharge limits by applying ALARA, using both specific design options and optimised operational procedures, to the satisfaction of the RB.

The actual emissions of radionuclides are generally a fraction of the limits specified in the licence, as demonstrated in the diagram in Figure 4 and Figure 5.

Table 7 Authorized discharges at COVRA

	Annual discharges	
Category	Air borne	Liquid
Alpha	1 MBq	80 MBq
Beta/gamma	50 GBq	200 GBq
Tritium/C-14	1 TBq	2 TBq

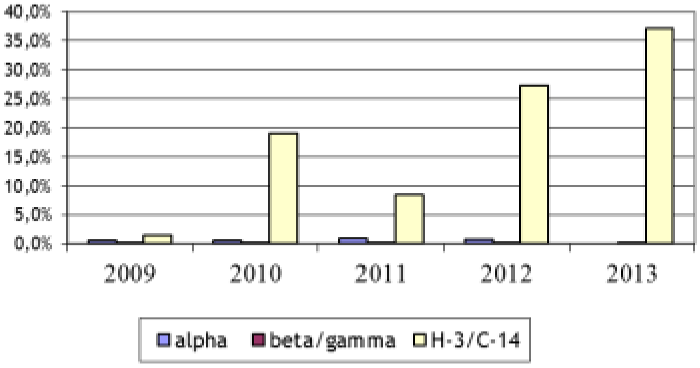

Figure 4 Emissions of radionuclides to the air as a percentage of the annual limit (source COVRA)[25]

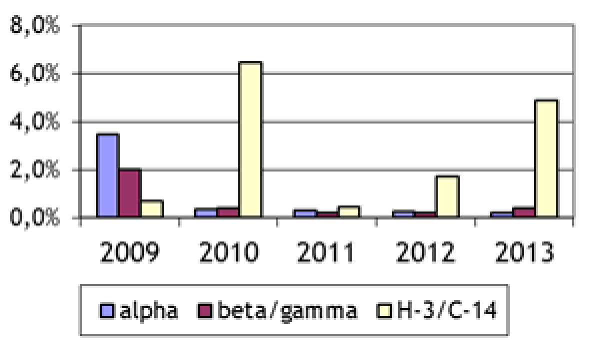

Figure 5 Emissions of radionuclides to water as a percentage of the annual limit (source COVRA).

24.3 Unplanned or Uncontrolled Releases

On-site emergency response plans of a nuclear facility describe the actions that should be taken after an accident. These plans include the establishment of zones for fire-fighting purposes and radiological criteria for releasing an off-site alarm. The on-site emergency plan forms the first barrier to prevent or to limit accidental emissions of radionuclides into the environment.

For each regulated nuclear facility off-site emergency provisions also apply, with their scope depending on the risks these facilities pose to the population and the environment. These provisions aim to mitigate the consequences of the release. This is described in more detail in the text on Article 25 of this report.

[25] These are the emissions to air from the AVG; there are also emissions from HABOG but these are very small compared to the AVG emissions.

Article 25. EMERGENCY PREPAREDNESS

1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.

2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

25 Emergency Preparedness

25.1 Emergency plans

The Nuclear Energy Act and the Safety Region Act Law clearly allocate the RB's responsibilities for preparedness and response for a nuclear or radiological emergency, including transport incidents.

Furthermore, Dutch regulations states in the Radiation Protection Decree (Bs), that LHs are required to make arrangements in preparing for interventions in case of a radiological emergency on-site. The LH has to prepare an emergency plan for each location, which has to be tested frequently. This general requirement is applicable for nuclear installations and sources, but is not further elaborated in the national regulations. Due to the small but diverse scale of the nuclear industry in the Netherlands the details of such obligations of the LHs are not regulated by law, but in the individual licences.

On-site emergency provisions

The operation licences of spent fuel and radioactive waste management facilities stipulate that a plan should be established and maintained. In the following the situation of the facilities of COVRA are used as an example.

The on-site emergency plan includes a specific emergency organisation with adequate staff, instructions and resources.

The emergency plan has three principal goals:

- to ensure that the operating organisation of the facility is prepared for any on-site emergency situation;
- to mitigate as much as possible the effects on the operating personnel of the facility and on the environment in the vicinity of the plant;
- to advise the relevant government bodies as effective as possible on emergency actions that should be carried out.

Specific procedures have been developed and adopted in order to prevent emergency situations and mitigate their consequences should they occur. With respect to the operation of the plant in abnormal situations, two types of emergency procedures exist:

- procedures for abnormal situations (incidents); and
- procedures for emergency situations, i.e. the symptom-based emergency procedures or "function-restoration procedures" that are applicable to design basis and beyond-design basis accidents.

COVRA has implemented on-site procedures for abnormal events as required by the operating licence. The procedures include the establishment of radiation levels at the border of the facility, which if exceeded, must be notified to the RB.

More specific, incidents or accidents with spent fuel or radioactive waste, which could cause emissions of radioactive material or an increase of the radiation level at any point at the fence of the facility by more than 200 nSv per hour, or cases involving missing drums of radioactive waste, must always be notified to the RB.

Off-site emergency provisions

Information on off-site emergency provisions can also be found in the Netherlands' sixth national report for the Convention on Nuclear Safety (CNS), published July 2013. Refer to its chapter on Article 16 of the CNS. In its section 16.1.n '*Off-site: EP&R and PAM*', additional information on the subject can be found.

Chapter VI of the Nuclear Energy Act describes the organisation and co-ordination of response to accidents with nuclear facilities by national and local authorities.

Threat categories

A distinction is made between facilities where accidents could potentially have an national impact (category A objects) and facilities where this is less likely and consequences are assumed to be restricted to the immediate surroundings of the facility (category B-objects). Facilities classified in category A typically include nuclear power stations. The COVRA facility is classified as a type B-object. However, in practice the national government will be involved in the emergency response because of the exclusive availability of dedicated nuclear expertise.

National nuclear emergency response plan

Chapter VI of the Nuclear Energy Act sets out the competences and the dependencies of the authorities that are responsible, *inter alia*, for the preparation and the organisation of measures in response to emergencies. Under Article 40 of the Act, the central government carries the bulk of the responsibility, both for the preparatory work as for actually dealing with any emergency that may arise in practice.

The response structure of nuclear emergency management is harmonized with the response structure for conventional emergencies. The 'Responsplan NPK 3.0' (Response Plan) describes the response structure for nuclear emergency management. The structure for conventional emergencies is described in the 'Nationaal Handboek Crisisbesluitvorming' (National Handbook for Decision making).

The 'Responsplan' defines the roles and responsibilities of local/national government and the Safety Region. For A-incidents the national authorities are responsible for decision making, the regional authorities are responsible for the implementation of the countermeasures (such as evacuation, sheltering etc.). The local fire brigade has to be involved in preparing the emergency planning (this is a licence requirement).

For B-incidents the mayor of the municipality where the incident occurs is responsible for the emergency response. Incidents with category B can be up scaled to A. The licence sets the requirement to inform the local fire brigade about the presence of radioactive material.

The 'Responsplan' organisation consists of the following groups:

- A national Warning Point (NWP) at the ministry of Infrastructure and Environment (inspectorate ILT) to which all nuclear incidents and accidents (and other environmental incidents) are reported. This centre is staffed and accessible 24 hours a day. The NWP is part of the departmental crisis coordination centre of the environmental department of the ministry of Infrastructure and Environment.
- A policy team at the National Crisis Centre (NCC) of the ministry of the Security and Justice. This team decides on the countermeasures to be taken to mitigate the consequences of the accident. It is composed of ministers and senior civil servants, and chaired by the minister of Economic Affairs, Agriculture and Innovation or the minister of Security and Justice.

- The National Nuclear Assessment Team (EPA-n). This team advises the policy team whenever there is a real threat of an off-site emergency in a nuclear installation or a radioactive release (in the Netherlands or in a neighbouring country). The team consists of a front-office, where an emergency situation is analysed and advice on measures is drafted, and back-offices for radiological, and medical information. The back-office for radiological information provides projected dose data on the basis of dispersion calculations and monitoring data concerning the environment, drinking water and foodstuffs. It is located within the National Institute for Public Health and the Environment (RIVM). RIVM operates the national radiological monitoring network (NMR) and in addition monitoring vans. It also collects data from other institutes. Alongside the radiological experts, the inspectorate branch of the RB (KFD) has an important role in assessing the status of the relevant nuclear installation, the accident prognoses and the potential source term. In addition KFD inspectors go to the accident site to support the emergency organisation.
- The National Information Centre is located within the ministry of Security and Justice. This centre is responsible for the coordination of information to be supplied to the public, the press, other national and international authorities and specific target groups, such as farmers.

Under Article 41 of the Act, the local authorities also have a role to play in making contingency plans for emergencies. The mayors of municipalities likely to be affected by accidents involving nuclear power plants located either within their boundaries or in their vicinity (including those across national borders) have drawn up emergency contingency plans in consultation with representatives of central government. These plans are obligatory under Article 7 of the Disasters and Major Accidents Act, and encompass all measures that need to be taken at both local and regional levels. Exercises are also held at regular intervals.

These measures will particularly apply to the potentially most dangerous step in the nuclear fuel cycle, i.e. nuclear power generation. The effects on waste management facilities or on waste management departments of other nuclear facilities are likely to be limited. For example, the safety assessments of the different treatment and storage buildings for radioactive waste at COVRA have demonstrated that even the most severe accident considered would not give rise to high risks outside the perimeter of the facility. Furthermore the waste management departments of the NPP Borssele and the research reactors are not the most vulnerable part of these facilities.

Intervention levels and measures

For purposes of emergency planning, the following generic intervention levels and measures are observed:

Direct intervention	(Projected Dose)
Direct evacuation:	1000 mSv E or 5000 mSv H_{th} (2 days)
Early evacuation:	200 mSv E (2 days)
Late evacuation:	50-250 mSv (first year dose)
Relocation/return:	50-250 mSv (first 50 years after return)
Iodine prophylaxis:	100 mSv (child); adult 1000 mSv (2 days)
Sheltering:	10 mSv E (2 days)
Indirect intervention	
Grazing prohibition:	5000 Bq I-131 per m^2
Milk(products), drinking water etc.:	500 Bq/l I, 1000 Bq/l Cs, 125 Bq/l Sr, 20 Bq/l alpha emitters.

The intervention measures and levels have been established by the RB following discussions with national experts in the relevant fields. International expertise and guidelines were also taken into account. There was no direct involvement of other stakeholders because the protection of the public in case of possible emergencies is a primary responsibility of national government. There are also derived intervention levels for foodstuffs, based on the appropriate EU regulations.

Emergency exercises

Integrated exercises (i.e. involving both the plant staff and the authorities) have proved a useful way of improving the effectiveness of the LH's emergency plan and organisation and the emergency organisation of the authorities. After a period in which exercises focused mainly on specific aspects of safety procedures and handling within the facility or exercising parts of the relevant organisations, integrated exercises are now being held on a more regular basis (national full scale every five years).

In addition to the regular schedule of exercises, special attention is to be paid to implementing the results of the Response Plan revitalisation process. A National full scale Exercise was held on May 25th 2005. The next exercise was held October 2011. In preparation for this exercise, which involved the Borssele NPP, training and several smaller exercises have been conducted to test the new arrangements and resources.

25.2 International aspects

The new (draft) National Nuclear Emergency Plan of the Netherlands, preparing for off-site emergency, deals with nuclear and radiological activities including several NPPs located close to the borders, whose off-site emergency-response planning zones cover Dutch territory.

It is recognized that the bilateral response measures do not completely match at different sides of national borders. Examples are reference accidents for NPPs and intervention levels, especially for iodine prophylaxis. This could lead to different zones for countermeasures on both sides of the border. This situation is difficult to explain to the public. Several initiatives are ongoing to harmonize or tune intervention levels and countermeasures with active participation of the Netherlands.

In March 2008 the Dutch policy regarding intervention levels and reference scenario's has been updated. Compatibility with border-countries has been improved, although slight differences due to national circumstances remain. The regional Nuclear Emergency plans for the NPPs Borssele and Doel are updated to implement the new policy. To learn more about national nuclear emergency plans and the approaches for decision making, arrangements are made to exchange observers from bordering countries in case of relevant exercises with NPPs in border areas.

The provision of information to the authorities in neighbouring countries is the subject of Memoranda of Understanding (MoU) that have been signed with bordering countries. The exchange of technical data (such as monitoring results and modelling-assessments) takes place on a regular basis and in a response-phase between the Netherlands and Germany. With Belgium, the same approach is in preparation. Information exchange at the international level is regulated by the Early Notification Convention of the International Atomic Energy Agency and the European Commission's Directive 87/600 ECURIE on urgent information exchange. On bilateral bases, information about (potential) nuclear or radiological emergencies will be exchanged between the respective national crises-coordination centers also.

Article 26. DECOMMISSIONING

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

(i) qualified staff and adequate financial resources are available;

(ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;

(iii) the provisions of Article 25 with respect to emergency preparedness are applied; and

(iv) records of information important to decommissioning are kept.

26. Decommissioning

Table 8 shows which nuclear facilities in the Netherlands are in operation and which have permanently been shut down.

Table 8 Status of nuclear facilities

Name of facility	*Type*	*Power*	*Status*	*Date of closure*
Borssele	NPP	515 MW_e	Operational	2033
Dodewaard	NPP	60 MW_e	Shut down	1997
High Flux Reactor (HFR), Petten	Research reactor	45 MW_{th}	Operational	N.a.
Low Flux Reactor (LFR), Petten	Research reactor	30 kW_{th}	Shut down	2010
Hoger Onderwijs Reactor (HOR)	Research reactor	2 MW_{th}	Operational	N.a.
Urenco	Uranium enrichment	N.a.	Operational	N.a.
COVRA	Waste treatment and storage facility	N.a.	Operational	N.a.

The Dodewaard NPP and the LFR are the only nuclear facilities that are in a state of decommissioning. The Dodewaard NPP was shut down in 1997 after 28 years of operation. It is now in a state of Safe Enclosure. The LFR was shut down in 2010.

National policy

In principle the operator is responsible for all aspects of decommissioning. According to new legislation, in force since April 2011, a nuclear facility shall be decommissioned directly after final shut down[26]. Decommissioning implies the implementation of all administrative and technical measures that are necessary to remove the facility in a safe manner, and to create an end state of 'green field'. Therefore, during the operational phase, the LH is required to develop a decommissioning plan, describing all the necessary measures to safely reach the end state of decommissioning, including the management of radioactive waste, record keeping, et cetera. This decommissioning plan shall be periodically updated every five years, and shall be approved by the authorities. The decommissioning plan finally becomes part of the decommissioning licence.

[26] The NPP Dodewaard, brought into state of safe enclosure in 2005, is excluded from this requirement.

During decommissioning, the LH is required to store records of the decommissioning, the release of material, and the release of the site. At the end of decommissioning, the LH can apply for withdrawal of the licence, after presenting an end report to the authorities proving that the decommissioning was completed. After withdrawal of the licence, records will be stored at COVRA.

The new legislation also requires the LH to make available adequate financial resources for decommissioning at the moment that these are required. Therefore, the LH will have to calculate the costs of all the activities described in the decommissioning plan, and provide for a financial provision offering sufficient security that all costs are covered at the envisaged start of decommissioning. The LH is free to choose the form of the financial provision: however, it shall be approved by the authorities.

In May 2002 a licence was granted to GKN, the operator of the NPP Dodewaard, to bring and keep the plant in a Safe Enclosure for 40 years. As the plant reached a state of Safe Enclosure in 2005, the licence is granted until 2045. One of the requirements in the licence for Safe Enclosure is to keep a record system of the inventory of all radioactive materials and components, which have become contaminated or activated during operation, and to update it every five years. Another requirement in the license is that the LH shall commence dismantling after 40 years. The LH will have to apply for a dismantling licence in due time. In the case that the LH would consider to commence dismantling activities earlier than after 40 years, he will have to apply for a new licence, substituting the current Safe Enclosure licence.

For the nuclear power station in Borssele the government has reached an agreement with the operator on immediate dismantling after closure (scheduled in 2033). There are no plans yet for the decommissioning of the other nuclear facilities.

26 (i) Qualified staff and financial resources

Qualified staff

The NPP Dodewaard is exempted from the requirement of direct decommissioning, and is scheduled to be in Safe Enclosure for a period of 40 years, starting from the year 2005. The licence requires the operator to appoint a radiological expert for this period, who is responsible for all radiation protection issues. These responsibilities include:

- To asses the results of routine monitoring procedures on locations where external radiation levels and/or contamination levels are likely to be encountered.
- To be immediately available for any information request regarding radiation protection by the RB.
- To take appropriate action in case of unplanned events.
- To ensure that radiation monitoring equipment is well maintained or replaced in case of dysfunction.
- To ensure that radioactive waste is managed in accordance with relevant safety standards[27] and is transferred at regular intervals to COVRA.
- To report periodically to the RB on radiation protection matters and general site conditions.

Financial resources

There has been a general understanding that the "polluter pays principle" applies. Consequently, the operators of the NPPs had made financial reservations for

[27] Predisposal Management of Radioactive Waste, including Decommissioning, IAEA Safety Series No. WS-R-2, IAEA, Vienna, 2000

decommissioning on a voluntary basis. The decommissioning funds are managed by the utilities.

LHs of the NPP and RRs are required to have a financial provision to cover the costs of decommissioning, which will have to be updated and approved by the authorities every 5 year, when the decommissioning plan is updated. The LH is in principle free to choose the form of the financial provision. Upon approval, the authorities will assess whether the financial provision offers sufficient security that the decommissioning costs are covered at the moment of decommissioning.

26 (ii) Operational radiation protection

The provisions with respect to radiation protection as set out in article 24 apply generically to decommissioning. In the specific case of the Dodewaard NPP, liquid emissions of radioactive material are not permitted, while airborne[28] emissions of radioactivity will (per year) be restricted to:

aerosols	1 GBq
tritium as HTO	2 TBq
carbon-14	50 GBq

Since January 2011 the release of carbon-14 is no longer measured as the plant has become free of carbon-14. All actual releases are less than 1% of these limits.

Radioactive waste management

COVRA is responsible for the treatment and storage of all kinds of radioactive waste. This comprises also the waste associated with the dismantling of a nuclear facility. Storage is conceived to take place on one single location, for a period of at least 100 years.

According to the Dodewaard licence, any radioactive waste arising during the period of Safe Enclosure will be kept in a dedicated and controlled area and managed according to applicable safety standards[29]. Waste quantities will be recorded and the records be kept at least during the full decommissioning period. Regularly, but at least within two years after packaging, this waste will be transferred to COVRA.

26 (iii) Emergency preparedness

The provisions set out under article 25 apply generically.

26 (iv) Record keeping

Record keeping is an important issue during a Safe Enclosure period of 40 years. The Dodewaard Inventory System (DIS) contains all known radiological data and other information provided by employees familiar with the operation of the reactor. Information stored in the DIS encompasses information on contaminated or activated parts and hot spots in the plant as well as technical information on the plant and its components.

In the preparatory phase to the Safe Enclosure the LH of the NPP Dodewaard completed the establishment of the DIS. The objective of the DIS is to describe in detail all relevant radiological data in the controlled zone of the NPP in a database. This database is designed both for present decommissioning activities leading to the Safe Enclosure, as well as for future dismantling operations. Since the dismantling activities will take place

[28] No liquid discharges are allowed during the safe enclosure period.

[29] Decree on the designation of COVRA as recognized service for the collection of radioactive waste, Bulletin of Acts and Decrees, 1987, 176

after 40 years, much attention will be given to keep the information in a form that ensures its accessibility by the systems in use at that time.

Besides that relevant records are kept at the plant itself and at the Gelders Archief, a state-controlled archive.

The Dodewaard record keeping system, of which the DIS is an important part, appeared as a good practice in an IAEA document of Long-Term Preservation of Information for Decommissioning Projects (Technical Report Series, nr. 467, August 2008).

In the case of the Borssele NPP, preservation of knowledge is less complicated, as the NPP will be dismantled directly after shut down. Furthermore, Dutch legislation requires that the operator keeps record and documentation during operation.

Section G Safety of Spent Fuel Management

ARTICLE 4. GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) Ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;

(ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;

(iii) take into account interdependencies among the different steps in spent fuel management;

(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

(v) take into account the biological, chemical and other hazards that may be associated with spent fuel management;

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

(vii) aim to avoid imposing undue burdens on future generations.

4 (i) Criticality and removal of residual heat

Management of spent fuel originating from Dutch reactors occurs at several different locations (in the Netherlands and abroad):

a) At the site of the nuclear power station;

b) At the sites of the research reactors;

c) In the storage facility for High-Level Waste of the Central Organisation for Radioactive Waste (COVRA);

d) At the sites of the reprocessing plant in France;

e) In spent fuel management facilities in the US for research reactor fuel returned under prevailing contracts.

Ad a) The Netherlands has two Nuclear Power Plants (NPPs), a 515 MWe PWR in Borssele, which is in operation, and a 60 MWe BWR in Dodewaard which has been shut down in 1997 and is now in a stage of Safe Enclosure. All spent fuel has been removed from the Dodewaard plant and transferred to the UK for reprocessing. The last transport of spent fuel from Dodewaard was carried out in April 2003 and the resulting reprocessing waste was returned to the Netherlands in 2010; for that reason, the following information is limited to the practices at the Borssele plant. Details on how the

Netherlands ensures adequate protection against criticality and residual heat are described in the documents mentioned under Art. 32.2 (ii) in Section B.

Ad b) The design of the fuel pools of the HFR at the Research Location Petten and the HOR of the Reactor Institute Delft comply with the provisions in NVR publication 2.1.10, adapted from IAEA Safety Series No. 50-SG-D10. This design ensures the removal of residual heat from the spent fuel, while the design of the fuel storage racks ensures control of criticality.

Ad c) The HABOG facility of COVRA is designed to store spent fuel from the research reactors, vitrified waste from reprocessing and other high-level waste from reprocessing, decommissioning, research activities or molybdenum production. In November 2003 the first spent fuel of the HFR reactor was stored, followed in 2004 by vitrified waste from reprocessing in France and by spent fuel elements from the HOR. At the end of 2013, 196 vitrified glass canisters, 244 compacted hulls and ends canisters, 27 spent fuel containers from the HOR in Delft and the HFR in Petten as well as 5 containers with spent uranium targets from molybdenum production were kept in storage. Details of the HABOG design are presented in the text under article 7 (i).

Ad d) All of the spent fuel of Dodewaard NPP and most of the spent fuel from Borssele NPP has been transferred to the reprocessing plants in the UK and in France respectively and has been reprocessed in previous years. Depending on the reprocessors' operating schedule, some quantity is temporarily stored in the reprocessors' storage pools pending shearing. It is being managed under the prevailing regulatory systems in France. The radioactive residues from reprocessing activities will in due time be returned to the Netherlands and stored in the HABOG facility at COVRA. All HLW of Dodewaard NPP was returned to the Netherlands in April 2010.

Ad e) Under the "Off-site Fuels Policy", which expired in 1988 for HEU fuel, the United States accepted foreign research reactor fuel. Consequently, up to that year the research reactors in the Netherlands sent their spent fuel back to the US. Also in later years occasional shipments with spent nuclear fuel to the US have taken place. This fuel will not be returned to the Netherlands.

Spent nuclear fuel mentioned under d) and e) is not being managed in the Netherlands and will not be addressed further in this report.

4 (ii) Minimization of Radioactive Waste

In the Netherlands, minimization of the generation of radioactive waste is achieved in different ways. First of all, and in accordance with the Basic Safety Standards, Dutch regulation requires that the use of radioactive material shall be justified; meaning that it shall be used only if there is no reasonable non-radioactive alternative available. Furthermore, according to Article 36 of the Dutch Radiation Protection Decree, a LH in possession of radioactive material is obliged to minimise the generation of radioactive waste. The LH is in principle free to choose its measures to achieve this. An example of such a measure is the preferred use of radionuclides with short decay times, allowing for a rapid decay below the exemption levels.

In the case of materials containing radionuclides of natural origin with activity concentrations below ten times the exemption levels, Dutch legislation provides the option to reuse these materials as far as reasonably practical. These materials can for instance be mixed with conventional bulk materials for the use in public works and infrastructure. For further information about this refer to section 32.1 (iv).

Regarding management of spent fuel, the choice whether or not to reprocess spent fuel is left to the operator. In the beginning of the nuclear era in the Netherlands the operators of the two NPPs Dodewaard and Borssele decided in favour of reprocessing for economic reasons. Uranium prices were relatively high and it was considered that the reprocessed uranium and plutonium could be reused either in fast breeder reactors or as MOX in the more conventional light water reactors. Reuse of resource materials is a way to reduce the amount of waste if not in an absolute sense, then at least relative to the electric output of the process. Fast breeder reactors have not yet been deployed commercially. Reuse of uranium from reprocessing facilities, although not fully competitive with fresh uranium, occurs on a limited scale. The reuse of plutonium as MOX fuel in light water reactors is accepted as a method to reduce the plutonium stocks.

On February 11, 2011, the government presented a position paper with the preconditions for new nuclear energy to Parliament. In the paper it is stated that it is an obligation for the LH of a nuclear power plant to evaluate their spent fuel management strategy every 10 years. The government decided to continue the existing policy on reprocessing, allowing the LH to decide on this. However, this policy will be evaluated every 20 years.

The operator of the Borssele NPP has arranged for the recycling of its reprocessing products (uranium, plutonium), and has been granted a licence for the use of MOX mid 2011. Regarding the products of past Dodewaard fuel reprocessing, the uranium was sold to a European NPP, while the plutonium stored at La Hague was sold to AREVA, a fuel fabricating company for fabricating MOX fuel. Plutonium stored at Sellafield was sold to NDA. NDA will use the plutonium for fabricating MOX fuel as well.

4 (iii) Interdependencies in spent fuel management

The basic steps in spent fuel management are not fundamentally different from those in radioactive waste management. For radioactive waste management the steps identified are generation, collection, treatment, conditioning, storage and disposal[30].

For spent fuel management pre-treatment should be taken as temporary storage with the aim of cooling down in the storage pool at the reactor site. Treatment is to be understood as reprocessing, while conditioning and (temporary) storage of spent fuel are steps aimed to keep the extracted resource material in a suitable condition for reuse in case this is the preferred option. The latter two management steps are so far occurring at the reprocessing plants. The policy of reprocessing is consistent with the Netherlands' decision to store the residues above ground for an interim period of 100 years. Reprocessing residues are produced in packages that facilitate their long-term storage without significant maintenance. The fuel from the non-power reactors is also packed in sealed canisters consistent with maintenance-free storage. The final step would be the geological disposal.

So far no decisions have been taken that would foreclose any of the available management options.

4 (iv) Protection of individuals, society and the environment

Radiation protection of workers

The basic legislation on nuclear activities in the Netherlands is the Nuclear Energy Act. A number of decrees have been issued, containing detailed regulations based on the provisions of the Act. The most important decrees for the safety aspects of nuclear installations and the radiation protection of the workers and the public are:

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse); and
- the Radiation Protection Decree (Bs).

The above mentioned decrees are fully in compliance with the Euratom Directive 96/29/Euratom laying down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

The Bkse requires the LH of a nuclear installation to take adequate measures for the protection of people, animals, plants and property. Article 31 of the Bkse states that a licence must contain requirements aimed at preventing the exposure and contamination

[30] International Atomic Energy Agency, The Principles of Radioactive Waste Management, Safety Series 111-F, Vienna, 1995.

of people, animals, plants and property as much as possible. If exposure or contamination is unavoidable, the level must be as low as is reasonably achievable. The number of people exposed must be limited as much as possible, and the LH must act in accordance with the individual effective dose limits.

The Bkse also states that these activities must be carried out by or under the responsibility of a person with sufficient expertise, subject to the judgement of the RB. This expert should occupy a post in the organisation such that he or she is able to advise the management in an adequate way and to intervene directly if he or she considers this to be necessary.

Written procedures must be available to ensure that the radiological protection measures that have to be taken are effective and to ensure that the above-mentioned expert is properly informed. Full details of these conditions are given in the Radiation Protection Decree (Bs), which also lays down more specific requirements on the protection of people and the environment from radiation.

In conformity with the Euratom basic safety standards the aforementioned Radiation Protection Decree stipulates a limit of 20 mSv per year as the maximum individual effective dose for radiological workers.

At the Borssele NPP an individual dose limit of 3 mSv per year has been set as an average long-term objective for radiological workers. This objective serves as an internal target within the context of meeting ALARA requirements. At the other sites in the Netherlands where spent fuel is managed similar operational dose constraints have been adopted.

Radiation Protection of the Public and the Environment

As prescribed in the operating licence of spent fuel management facilities, all discharges of radioactive effluents must be monitored, quantified and documented. The LH must report the relevant data on discharges and radiological exposure to the RB. On behalf of the RB, the National Institute for Public Health and the Environment (RIVM) regularly checks the measurements of the quantities and composition of discharges. The LH is also required to set up and maintain an adequate off-site monitoring programme. This programme normally includes measurements of radiological exposures and possible contamination of grass and milk in the vicinity of the installation. The results are reported to - and regularly checked by - the RB. Under Article 36 of the Euratom treaty, the discharge data must be submitted to the European Commission each year.

Protection of the public and the environment against the effects of abnormal operational conditions, such as accidents, is ensured by special design features of the buildings and installations (see also text under Article 7).

4 (v) Biological, chemical and other hazards

Since at the NPPs no other activities are being undertaken than transferral of fuel assemblies from the reactor core to the storage pool and in a later stage transport from the NPPs to the reprocessing plants in certified and accident proof packages, chemical or other hazards are not considered to be a significant issue in spent fuel management.

At the HFR in Petten and the RID in Delft fuel assemblies are also transferred directly from the reactor core to the storage pool. After a cooling period of five years these are transported to COVRA in certified and accident proof packages. Therefore, chemical or other hazards are not considered to be a significant issue in the context of spent fuel management.

Physical protection measures are implemented on the basis of a security plan, which is specific for the site, and has to be approved by the RB.

At the facility of COVRA the spent fuel of the research reactors is received in dedicated storage and transport casks. These casks are designed to prevent hazards. At COVRA's facility, HABOG, the spent fuel is repacked in a steel canister, filled with a noble gas (helium) and stored in a noble gas (argon) atmosphere while the special design of the storage vaults provides for shielding and cooling as required. The inert gas atmosphere prevents chemical oxidation during long-term storage. Other hazards such as flooding, gas cloud explosions, airplane crashes, and terrorist actions etc. were taken into account in the design of the facility.

4 (vi) Impacts on future generations

Scenarios that could, in principle, lead to higher exposures of future generations than those, which are considered justifiable for the current generation are:

- Bad management of spent fuel, resulting in uncontrolled discharges into the environment at some time in the future;
- Prolonged authorized discharges of long-lived radionuclides into air and water (e.g. estuaries or the sea). This could result in a gradual build-up of long-lived radionuclides in the atmosphere, causing humans to be exposed to ever increasing concentrations of radioactivity or to delayed exposure due to transportation and concentration mechanisms in food chains which become significant only after an equilibrium situation has been reached.

As stated before, the current policy in the Netherlands with regard to spent fuel management of the NPPs is not to use the full capacity of the storage pools for on site storage of spent fuel. As required by a pertinent condition in the operation licences of the nuclear facilities, regular transports of spent fuel from the NPPs to the reprocessing plants are carried out to ensure that this favourable situation is being maintained.

For the spent fuel of the research reactors the same approach applies. The clear objective is to limit as far as practicable the amount of spent fuel in the storage pool at the reactor site. Regular transports of spent fuel to the HABOG storage facility will take place.

As regards the authorized discharges from the management of spent fuel it is noted that the application of the ALARA principle has a beneficial effect on the actual discharges. All spent fuel management facilities have succeeded in keeping their discharges far below the limits authorized by the RB. This in turn ensures that future generations are not less protected than the current generation under the internationally endorsed radiation protection criteria and standards (see also text under Art. 4 (iv)).

4 (vii) Undue burdens on future generations

The strategy of the government of the Netherlands with respect to spent fuel management is founded on the principle that the generation which is responsible for the arising of a hazardous commodity such as spent fuel is in the best position to provide for good management now and to offer possible and sustainable solutions for the future.

For spent fuel from the NPPs the decision has been taken to reprocess it with the aim to recover fissile material for reuse and to immobilize the fission products into a stable glass matrix of High-level Waste (HLW). The intermediate-level reprocessing residues will also be packed in such a way, that long-term safe and maintenance-free handling is possible. Consequently, it is envisaged that future generations will not have to be concerned with the management of spent fuel from the NPPs. The 'burden' for future generations is limited to execution of the final disposal for the HLW, which according to prevailing expert views is already in a suitable condition for disposal. Alternatively, if other options become available in the future, it would be the execution of these other, and presumably preferred, options.

Spent fuel from the research reactors will be conditioned, packaged and subsequently stored in the HABOG facility at COVRA. The care for that material will be passed on to the next generation. However, not only the burden of this care will be passed on to the next generation, but also financial resources and technical knowledge required setting favourable conditions for the good management of the spent fuel.

Article 5. EXISTING FACILITIES

Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

5 Existing facilities

The operator of the Borssele NPP has chosen for the option of reprocessing of its spent fuel. Some spent fuel is kept in short-term storage in the spent fuel pool at the Borssele reactor site, waiting for transport to the reprocessing facility. The management of spent fuel of the Borssele NPP that is sent for reprocessing in France is exercised under the authority of the French government.

The only other spent fuel management facility is the HABOG facility, managed by COVRA. This facility is designed to store conditioned spent fuel from the research reactors and has been commissioned in 2003. In this case an upgrade of the safety of this facility is not applicable. However, under the operating licence there is a condition to evaluate every five years the actual safety level, the operational experience and the developments in general regarding the safety of this spent fuel management facility. The first evaluation has been completed at the end of 2009 and the recommendations were implemented by July 2011.

ARTICLE 6. SITING OF PROPOSED FACILITIES

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:

(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;

(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;

(iii) to make information on the safety of such a facility available to members of the public;

(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.

6.1 (i) Evaluation of site-relevant factors

The applicable design measures aimed to cope with the site characteristics, such as proximity to the sea and consequently the risk of flooding, are described in more detail in the text under Article 7.

6.1 (ii) to (iv) Impact of facility and providing information about it.

The HABOG facility of COVRA is the only facility for the long-term storage of spent fuel and high-level radioactive waste in the Netherlands. The storage pools at the research and power reactor sites are not intended for long-term storage and are consequently not considered in this report.

The site selection procedure for COVRA featured a two-track approach.

The first track started with the establishment of a commission of high-ranking officials from the public domain. The first step in the procedure was the formulation of selection criteria for the site of the COVRA facility. The selection criteria for candidate sites were mainly based on considerations of adequate infrastructure and the location in an industrialised areaMany sites complied with these rather general criteria. Twelve of these were selected by the commission as being suitable in principle and were judged not to have features that would be prohibitive for the planned activity. For the selection of the preferred sites the co-operation of the local authorities was sought. In order to facilitate the negotiations with the local authorities, in a separate track, a site-independent Environmental Impact Assessment (EIA) was performed (see below). As expected, this demonstrated essentially the absence of any adverse effect on the environment. However, this conclusion did not lead to an offer from local administrators. Although there are in principle legal procedures for overruling a refusal by a local or regional authority to accept a potentially suitable storage or disposal site, as a rule the consensus model is followed for the allocation of a site. In practice this limits the number of available sites to just a few, since most municipalities consider the presence of a radioactive waste management facility as undesirable. Consequently, the preferred sites are basically selected on the basis of willingness of local authorities to co-operate in the establishment of such a facility. Eventually, only two municipalities were willing to accommodate a facility for storage of spent fuel and radioactive waste. COVRA expressed a preference for the present location in the Sloe industrial area in the south-west part of the country close to the NPP Borssele.

As mentioned above, the second track towards the selection of a site was an assessment of the possible environmental effects from a spent fuel and waste storage facility for a generic site. The Environmental Impact Statement was published in 1985. After site selection, the EIS was re-written for the specific location in the Sloe area and submitted as part of the licence application to the competent authority. This site-specific Environmental Impact Assessment (EIA) was performed by considering three operational alternatives (the proposed facility, a facility with maximum volume reduction and a facility with a maximum reduction of handling operations). Both the EIS and the licence application were made available to the public that could express its view. International notification was required like for any plan for the disposal of radioactive waste, according to a procedure established in Article 37 of the Euratom Treaty.

Since spent fuel management facilities can in principle give rise to discharges of radioactive materials and hence could possibly affect other countries, information of such a plan is provided to the European Commission, which will have an assessment made by experts.

A table with the cases in which an EIA is required, is presented in the text under article 8.

6.2 Siting in accordance with general safety requirements

The protective measures referred to in the text under Article 4 (iv) ensure that the effects imposed on human health and the environment in other countries are not more detrimental than those which are deemed acceptable within national borders.

The design features of these facilities, aimed to provide protection against accidents/incidents as mentioned in the text under Article 7, will ensure that also accidents do not cause undue risks beyond national borders.

ARTICLE 7. DESIGN AND CONSTRUCTION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

7 (i) Limitation of possible radiological impacts

Spent fuel from the research reactors is stored in the HABOG facility at COVRA. HABOG was commissioned in 2003. A schematic cross-section of the HABOG facility is presented in Figure 6.

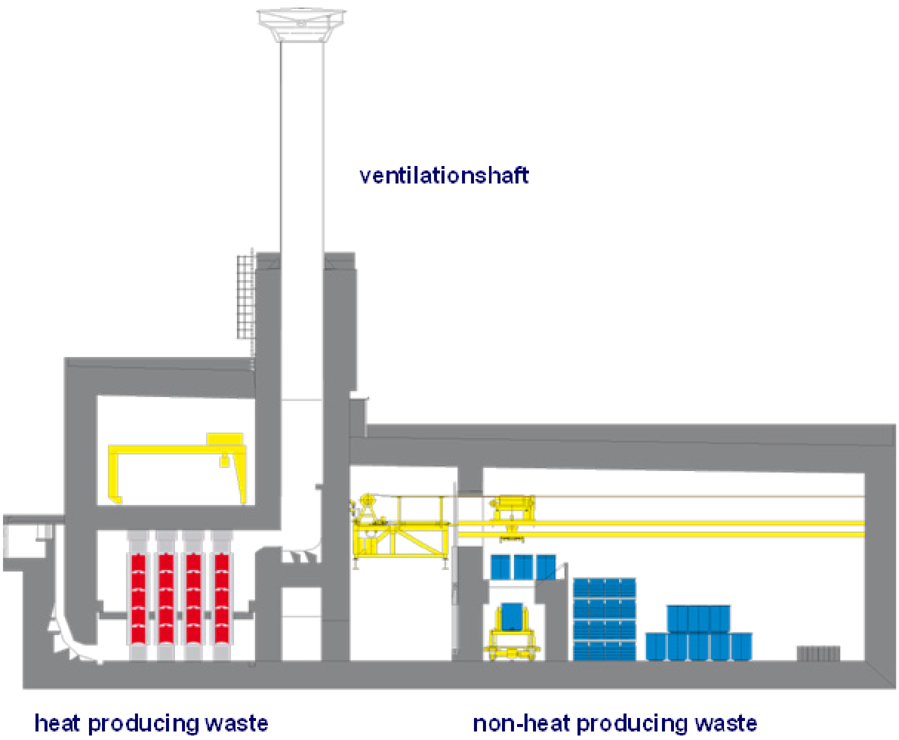

Figure 6 Cross-section of the HABOG facility

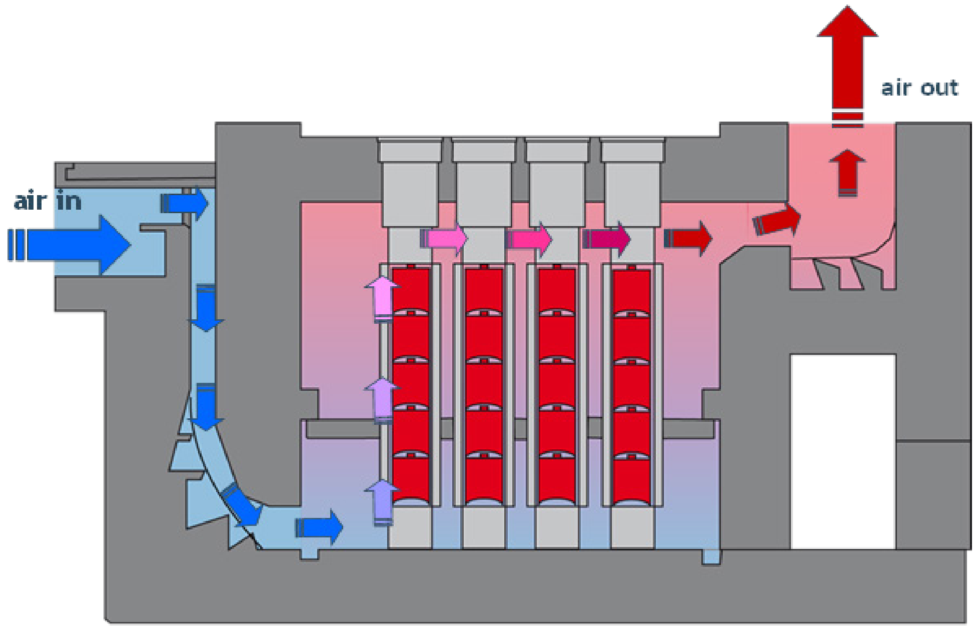

Figure 7 Storage wells for SF and HLW in the HABOG, with passive cooling

The HABOG is a vault-type storage facility divided in two separate compartments. The first compartment is used for the storage of canisters and other packages containing high-level waste that does not need to be cooled (compacted hulls and ends and other high-level radioactive waste). The second one is used for the storage of vitrified HLW from reprocessed SF originating from the NPPs, for SF originating from the research reactors and spent uranium targets from molybdenum production. SF and spent uranium targets, and vitrified HLW are stacked on 5 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 to allow passage of cooling air. The double jacket ensures that there is never direct contact between SF, spent targets or waste canisters and the cooling air. The cooling system is based on the natural convection concept. A schematic diagram of the storage compartment for SF and vitrified HLW is represented in Figure 7.

The leading principles of operational safety in the management of spent fuel (and radioactive waste) are the following:

- Isolation
- Control
- Monitoring

For the design of the HABOG the guidelines from ANSI/ANS 57.9-1992 have been applied. Broken down to the abovementioned operational safety principles the following requirements should be fulfilled:

Isolation:

- SF (or radioactive waste in general) should be contained in a way that at least two barriers to the release of radioactive material are present.
- Adequate shielding of the radiation emitted by the waste should be maintained.

Control

- Assurance of a condition of sub-criticality of the spent fuel and targets by application of neutron absorbers and by a suitable geometry of the spent fuel and targets.
- Assurance of adequate cooling of heat-generating HLW.

- Possibility to move spent fuel and targets or HLW from the storage wells with a view to repackaging, relocating to another storage compartment or removal from the facility.

Monitoring

- Monitoring the containment of the storage wells, the temperature of the wells, the shielding capacity and the emissions by inspections and/or measurements.

These requirements have been implemented in the following ways:

Isolation:

- The presence of at least two containment barriers between the SF/HLW and the environment is achieved by passive components, constructions and materials such as the immobilization matrix of the material itself, by the packaging, by the storage wells and by the construction of the building.
- Adequate shielding is achieved through the presence of 1.7 m thick concrete walls.
- The HABOG facility is designed to withstand 15 different design-base accidents in order to prevent consequences for the population or the environment. These design base accidents include flooding, fire, explosions in the facility, earthquakes, hurricanes, gas explosions outside the facility, an aircraft crash, a drop of a package from a crane etc. The robustness of the construction of the building ensures that none of these accidents, whether arising from an internal cause or initiated by an external event, will result in a significant radiological impact.

Control

- Sub-criticality is maintained by assuring that both under normal operating conditions and under accident conditions the reactivity factor k_{eff} will never exceed a value of 0.95.
- Permanent cooling of the canisters with SF, spent targets and high-level radioactive waste is assured by using a passive air convection system. Calculations have demonstrated that the thermal specifications of the SF/HLW will never be exceeded.
- The HABOG facility is laid out in such a way that there is always one spare storage compartment for each category of waste available.

Monitoring

- HABOG has a passive cooling system for SF and HLW based on natural air convection. The cooling air never comes in contact with the radioactive material or any contaminated surfaces but is nevertheless monitored. HABOG has also a mechanical ventilation system. This system is designed to keep the building (except for the SF and HLW vaults) at an under pressure. The air flow through the building is directed from areas with no contamination towards areas with a potentially higher contamination. Both incoming and outgoing air is monitored and filtered.

7 (ii) Conceptual plans and provisions for decommissioning

The spent fuel and HLW storage facility HABOG is designed for a storage period of at least 100 years. Since the technologies are likely to change considerably in this period, no firm plans for decommissioning have been made. Moreover, the facility is designed and operated with the objective to prevent contamination. The SF and waste packages accepted in the building have to be free of (non-fixed) contamination (IAEA Safety Requirements No. TS-R-1). The areas in the HABOG which may be contaminated with radioactive material due to handling of SF/HLW are limited. The finishing of all surfaces in places where radioactive material is being handled, is such that any radioactive contamination can be easily removed. Consequently, it is unlikely that major structures and components of the building become contaminated. Keeping the buildings clean forms an integral part of the operations, which prevents or limits the build-up and spreading of any contamination. By regularly conducting contamination measurements, any contamination is timely detected and removed. Finally, the consequences of any contamination are limited by compartmentalisation.

7 (iii) Technologies incorporated in the design and construction

One of the most conspicuous features in the design of the HABOG facility is the application of natural convection for the control of the temperature of the SF and HLW canisters. The choice was made in favour of a system of natural convection because of its inherent safety characteristics: cooling is ensured under conditions of loss of electric power and it is insensitive to human errors. It is a reliable cooling method, which is common practice these days. Much experience with this system has been gathered in France.

ARTICLE 8. ASSESSMENT OF SAFETY OF FACILITIES
Each Contracting Party shall take the appropriate steps to ensure that:
(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;
(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

8 (i) Safety Assessment

A licence for a spent fuel management facility is only granted if the applicant complies with the national requirements and, more in general, with international (IAEA) established safety goals, codes and guides, as well with the international state of the art. The applicable parts of the IAEA Safety Standards (Safety Fundamentals, Safety Requirements and Safety Guides) must be covered or incorporated in the Safety Report (SR), which is submitted to the RB. A typical example is compliance with the requirements addressing the site-specific external hazards, such as military aircraft crashes, external flooding, seismic events and gas cloud explosions.

After obtaining the licence but before construction the LH drafts and submits to the RB the Safety Analysis Report (SAR) and supporting topical reports. In these reports detailed descriptions of the facility are presented as well as an in-depth analysis of the way in which the facility meets the requirements and the international state of the art.

After construction and commissioning of the spent fuel management facility the LH submits the SAR with a description of the as-built facility and the results of the commissioning to the RB for approval before start of the routine operation. Since full compliance is expected with the Safety Report, no formal update of the safety assessment or environmental assessment is foreseen and there will be no need for revision of the Safety Report, which is the basis of the licence. However, all the results of the commissioning programme are incorporated in a full update of the detailed SAR.

As IAEA regulations are fairly general and hence lack technical detail, the licensing basis for the HABOG building was based on the French state of the art for SF/HLW storage. As an independent assessment tool for the SAR the USA ANS/ANSI standard 57-9-1992 was incorporated.

Selected items or documents in the SAR are studied in more depth, often using assessment by independent organizations. These key documents are submitted to the RB for approval. Other documents are submitted for information only.

8 (ii) Updated assessments before operation

In the Environmental Impact Assessment Decree[31], which is based on the EU Council Directive 97/11/EC on "Assessment of the effects of certain public and private projects on the environment", spent fuel and radioactive waste management facilities are designated as activities which are subject to the Decree. An Environmental Impact Statement is always mandatory in the cases indicated in Table 9.

Table 9 Situations in which an EIA is required

Activities	*Cases*	*Decisions*
The creation of an establishment: ***a. for the treatment of irradiated nuclear fuel or high-level radioactive waste,*** ***b. for the final disposal of irradiated nuclear fuel,*** ***c. solely for the final disposal of radioactive waste, or*** ***d. solely for the storage of irradiated nuclear fuels or radioactive waste from another establishment.***	In relation to the activity described at d, in cases where the activity relates to the storage of waste for a period of 10 years or longer.	The decisions to which part 3.5 of the General Administrative Law Act and part 13.2 of the Act apply.

The RB is competent for both the safety assessment and the environmental impact assessment.

The facilities at COVRA meet the descriptions under the entries *a* and *d* and an EIA had to be conducted. As reported in the text under Article 6.1 the first EIS for COVRA was published in 1985. The most recent EIS was carried out in 1995 as a consequence of an envisaged modification in the design of the facility for the storage of SF and HLW. This again was the result of a reassessment of the estimated quantities of SF and radioactive waste to be stored due to the cancellation of expansion plans in the nuclear energy programme. This eventually led to a choice for the current design of the HABOG.

Both the EIS of 1985 and the subsequent EIS of 1995 predicted that the envisaged activities of the COVRA facility would not cause any detrimental effect on the population and the environment.

With a view to monitor whether the predicted favourable outcome of these statements could be confirmed in practice an evaluation was made of the health and environmental effects in 1995 after 3 years of operation of the facility for low- and intermediate-level radioactive waste.

It appeared that the impact to the environment was even lower than assumed in the EIS, because all emissions of radioactive materials and chemical hazardous materials – both

[31] Environmental Impact Assessment Decree, Bulletin of Acts and Decrees 1999, 224.

airborne and waterborne – remained far below the limits authorized in the operating licence. The successive annual reports of COVRA on releases and radiation levels at the fence of the facility show that this favourable situation is continuing.

ARTICLE 9. OPERATION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;

(v) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vi) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

9 (i) Licence to operate

After the commissioning of the SF/HLW storage building COVRA submitted the report with the description of the as built-facility and the results of the commissioning to the RB for approval. This document demonstrated full compliance with the licence and the SR. During the first operational phase, when the storage building is accepting its SF and HLW, the RB closely followed the safety of the installation by inspections and assessment of the LH’s periodic operation reports.

For the long-term storage phase a licence condition stipulates that the safety of the installation shall be periodically reviewed in the light of operating experience and new insights. A review of operational aspects shall be performed once every five years, whilst a more basic review shall be conducted once every ten years. The latter may involve a review of the facility design basis in the light of new developments in research, safety thinking or risk acceptance.

According to Article 15, sub b of the Nuclear Energy Act licences are required for building, taking into operation and operating a nuclear installation. In the specific case of a spent fuel and radioactive waste management facility these licences are usually granted by one ministerial decision. The issue of a licence is conditional on a favourable outcome of the review by the RB of the safety assessment of the facility and on a favourable outcome of the EIA.

A safety assessment for the operation of a spent fuel management facility is made by the operator of the facility as part of the application for a licence to operate the facility or to modify the facility. The technical specifications and the assumptions underlying the postulated accident scenarios are laid down in a Safety Analysis Report. It is the responsibility of the operator to demonstrate to the RB that the situation as built is in accordance with the technical specifications and that the safety requirements can be met.

9 (ii) Operational limits and conditions

The licence conditions for the operator, which are attached to and form a constituent part of the operating licence, specify the obligations that the operator has to meet. Some of these licence conditions form the basis for the establishment of operational limits that ensure that under foreseeable circumstances the authorized limits, as set by the licence, will not be exceeded. Examples of operational safety limits are e.g. conventional safety measures like the availability of emergency power supply, noise limits, and standard crane operational requirements. Other licence conditions demand that periodic reviews be carried out with the aim to assess whether the assumptions, which form the basis of the safety assessment of the facility, are still valid. The results of these periodic reviews are submitted to the RB for further evaluation. When deemed necessary a revision of the operational limits will be undertaken.

9 (iii) Operation, maintenance, monitoring, inspection and testing

The development of a management system for maintenance of safety-related installations and components is required by the licence conditions for the operator as specified in the operating licence. The LH has such a management system in place.

Examples of such licence conditions include:

- Establishment of internal instructions for the proper operation and maintenance of installations, systems and components;
- Demonstration of a condition of sub-criticality in all systems and installations under all foreseeable circumstances;
- Demonstration of compliance with the thermal limits set for the heat-generating waste;
- Record keeping of all authorized discharges of radioactive materials to the environment;
- Provision for a five-year evaluation of all safety-related procedures with the aim to determine whether the criteria under which the licence was awarded are still applicable.

9 (iv) Engineering and technical support

During the active period of COVRA, waste will be accepted and actively stored in the facility. From the moment that no more waste is generated or returned from reprocessing facilities, the HABOG facility will be in its passive phase (design basis ~100 years). Only maintenance and control will take place. After 2130 a final disposal route should become operational.

The money needed for maintenance during this passive period (as well as for the disposal) has been paid in advance and was calculated as discounted value. The money is put in a capital growth fund, managed by COVRA. Because money is available support can be purchased.

The specific policy in the Netherlands requires long-term planning for COVRA’s activities. Initially, for the HABOG facility an active operating phase was foreseen until and including 2014 (the originally anticipated closure date of the Borssele NPP). However, as the operational life of the NPP at Borssele has been extended to 2033, and thus more HLW will be generated, this date had to be reconsidered.

9 (v) Reporting of incidents significant to safety

According to the licence conditions the operator is required to report events that have an impact on the safe operation of the facility to the RB. The operator is also required to make arrangements for responding adequately to incidents and accidents. The RB has approved this arrangement.

9 (vi) Programmes to collect and analyse relevant operating experience

The conditions attached to the operating licence stipulate that both operating experience from the LH organisation and information obtained from other organisations involved in the management of spent fuel and/or radioactive waste is collected and analysed. This requirement applies both to normal operating experience and to incidents or accidents.

9 (vii) Decommissioning plans

Following the new decommissioning legislation, a (very) preliminary decommissioning plan has recently been made by COVRA and sent to the authorities for approval. The waste stored in the HABOG-facility is delivered in a conditioned form, packaged in stainless steel canisters, in principle not requiring any further treatment or repackaging. The waste form is considered to be a condition that is suitable for disposal in due time. This ensures that radioactive contamination of the HABOG is highly unlikely. Decommissioning of the HABOG facility will not differ significantly from the demolition of any other robust building outside the nuclear sector.

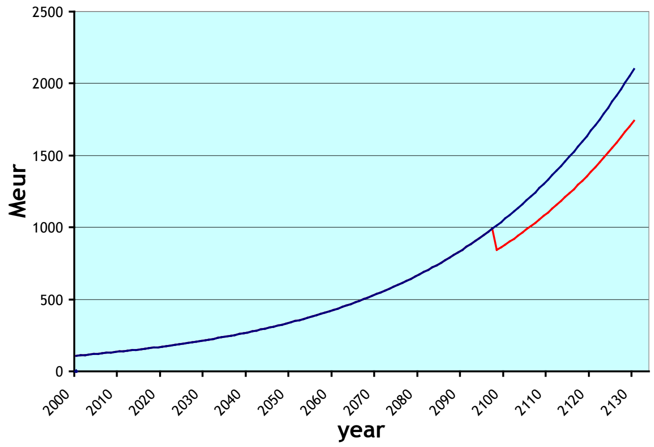

Figure 8 Growth of the radioactive waste management fund

The adjacent graph (Figure 8) is a reference line representing expected growth of the fund for future radioactive waste management. It shows that, if in 2100 money would be drawn from it for the construction of a replacement of the HABOG and other facilities (150 Meur), it would cause a delay of not more than several years (red line in graph). In that period the fund would grow to its original level.

ARTICLE 10. DISPOSAL OF SPENT FUEL

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.

10 Disposal of spent fuel

No formal decision has been made regarding disposal of spent fuel. The spent fuel that originates from the research reactors will be stored at the HABOG-facility. In a later stage it will be decided whether the fissile material will be extracted for further use or whether it will be conditioned in a suitable form for disposal.

Section H Safety of Radioactive Waste Management

ARTICLE 11. GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;

(ii) ensure that the generation of radioactive waste is kept to the minimum practicable;

(iii) take into account interdependencies among the different steps in radioactive waste management;

(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

(vii) aim to avoid imposing undue burdens on future generations.

11 General safety requirements

See the text under Article 4.

ARTICLE 12. EXISTING FACILITIES AND PAST PRACTICES

Each Contracting Party shall in due course take the appropriate steps to review:

(i) the safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;

(ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.

12 (i) Safety of facilities

The only existing radioactive waste management facility in the Netherlands is the COVRA waste treatment and storage facility at Borsele. It consists of an operational waste treatment and waste storage facility for low- and intermediate-level radioactive waste and a treatment and storage facility for HLW and SF (HABOG). On the premises of COVRA a building was also constructed for the storage of NORM waste, in cases where the regulatory exemption limits are exceeded. Another building is present for the storage of depleted uranium oxide from the Urenco enrichment plant in Almelo. The LILW facility is equipped with volume-reducing installations including a 1500 ton super compactor, an incinerator for liquid organic waste and an incinerator for animal carcasses. The LILW facility has now been in operation for more than 18 years. The whole waste management facility got a major regulatory overhaul in the framework of a revision of the licence for the construction and operation of the HABOG.

Under the operating licence of COVRA there is a condition to evaluate every five years the actual safety level, the operational experience and the developments in general regarding the safety of the whole COVRA facility, including the HABOG facility. All procedural, operational and administrative aspects are evaluated. The first evaluation has been completed at the end of 2009 and the recommendations were implemented by July 2011.

For the intermediate- and high-level waste present in the Waste Storage Facility at the research location Petten, several options for conditioning, repacking and transport to COVRA are under investigation. The waste has to be handled in a dedicated hot cell facility before it can be transferred to the COVRA. It is intended that all the waste has to be transferred from Petten to COVRA before 2020.

12 (ii) Past practices

1,765 drums with historical waste are still stored at the NRG Waste Storage Facility at Petten. This waste, resulting from four decades of nuclear research at that location, exists of high active waste containing fuel material residues and some highly active waste not including fuel material (fission and activation products). The waste is stored in metal drums placed inside concrete-lined pipes.

In the course of a two-year campaign between 1999 and 2001 the waste was inspected and levels of activity were determined. The inspection revealed evidence of corrosion in drums containing highly active mixed waste, due to the presence of PVC. Prior to the inspection campaign, the potential implications of packaging highly active waste together with PVC were unknown. This practice now no longer occurs.

It is intended that those drums containing PVC, about 300 in total, will be sorted, repacked, and prepared for storage at COVRA. All other containers will also be treated, repacked and shipped to COVRA. It is intended that all legacy waste from the Waste Storage Facility at Petten will have been removed before 2020.

The owner of this historical waste, the ECN, will have to pay for all management costs, including the commissioning, operation and decommissioning of the necessary facilities, where the waste will be conditioned and repacked before transportation to COVRA. Operational costs for storage will be paid annually and the costs for the passive storage period as well as for final disposal will be paid in 2015.

ARTICLE 13. SITING OF PROPOSED FACILITIES

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:

(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;

(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;

(iii) to make information on the safety of such a facility available to members of the public;

(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.

13 Siting of proposed facilities

See text under Article 6.

ARTICLE 14. DESIGN AND CONSTRUCTION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;

(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;

(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

14 (i) Limitation of possible radiological impacts

In the text under Article 7 a description is given of the building and installations for the handling and storage of SF and HLW.

A description of the facilities for the processing and storage of Low- and Intermediate Level Waste (LILW) of COVRA is given below.

Normal operation

Processing of LILW occurs in a special building, the waste processing building (AVG). Drums of waste collected from LHs from all over the country are sorted with respect to type and/or processing method to be applied. The following categories are distinguished:

Vials containing scintillation liquid

The vials are crushed. The liquid is collected and, if possible, separated in an organic and an inorganic part. The organic liquid is burned in an incinerator, the aqueous liquid is treated and the resulting radioactive residues are solidified and conditioned. The solid components are super compacted and conditioned in concrete.

Liquid waste

Unless their composition is exactly known liquids are considered as mixtures of organic and inorganic components. Further treatment takes place in the water treatment system where as far as possible the dissolved radioactive material is deposited with chemical agents or by electrochemistry. Usually the radioactivity concentrates in the deposit and can be separated by filtration. The purified aqueous liquid is then almost free of contamination and can be discharged within the authorized limits. The radioactive residue is dried and compacted in the same way as other solid waste. Organic constituents of the waste water can also be removed through biological route. Liquids that cannot be treated in the water treatment system are incinerated.

Animal carcasses

Carcasses of laboratory animals, which are contaminated with radioactivity, are burned in a dedicated incinerator. The ashes are collected, super compacted and immobilised in concrete.

Compactable waste

Most of the volume of radioactive waste collected by COVRA is solid compactable waste. Its volume is reduced by compacting the waste-containing drums with a 1500 tonnes super compactor. The compacted drums are transferred to drums with a larger diameter and consolidated with concrete. The conditioned waste is transferred to the storage building.

Sources and other waste

Used sealed radioactive sources are mixed with cement and stored in drums. Other radioactive waste consisting of large sized components is first pre-compressed, or sheared and cut to fit the compacting drums. Again conditioning for long-term storage is done with cement grout and concrete.

Storage buildings (LOG, COG and VOG)

The buildings for the storage of conditioned radioactive waste (LOG) are robust concrete buildings with floors capable of carrying the heavy load of drums stacked in 9 layers. The moisture content in the air of the LOG is controlled to prevent condensation and thus corrosion of the metal surfaces of the stored drums.

In the COG building 20-ft containers with large volumes of NORM from the phosphor producing industry are stored. The building is constructed of lightweight materials in view of the relatively low radiation levels of the waste. Again, air humidity is controlled in order to prevent corrosion

In the VOG building depleted uranium from the uranium enrichment plant in the form of uranium oxide (U_3O_8) is stored in containers of ca 3 m^3. A concrete structure is needed in order to obtain the required shielding. Air humidity control is standard here as well.

Accidents and Incidents

The buildings for treatment and storage of LILW are designed to withstand small mishaps during normal operation and internal accidents such as fire and drops of a radioactive waste container during handling (see also the text under Article 24.1.(iii)). The treatment building (AVG) is also designed to withstand the forces of a hurricane.

These buildings are not designed to provide protection against more severe accidents such as:

- Flooding of the buildings
- Earthquakes
- Gas cloud explosions
- Release of toxic and/or corrosive substances
- Crashing aircraft (military aircraft)
- External fire

However, an analysis of the consequences of beyond design accidents has demonstrated that not only the probability of occurrence but also the radiological impact is limited. The unconditional risk of such accidents has been assessed as lower than 10^{-8}.

14 (ii) Conceptual plans and provisions for decommissioning

See the text under Articles 7 (ii) and 9 (vii).

14 (iii) Closure of disposal facilities

In 1993 the government adopted a position paper[32] on the long-term geological disposal of radioactive and other highly toxic wastes. This position paper was presented to parliament, and forms the basis for the further development of the national radioactive waste management policy: any geological disposal facility to be constructed shall be designed in such a way that each single step in the process can be reversed. The consequence of this position is that retrieval of the waste, if deemed necessary for whatever reason, is always possible.

The overriding reasons for introducing the concept of retrievability were derived from considerations of sustainable development. Waste is considered a non-sustainable commodity and its arising should be prevented. If prevention is not possible, the reuse and/or recycling of this waste is the preferred option. By disposing of the waste in a retrievable way, its eventual management will be passed on to future generations which will thus be enabled to make their own decisions. This could include the application of more sustainable management options if such technologies become available. The emplacement of the waste in the deep underground would ensure a fail-safe situation in case of negligence or social disruption.

Retrievability of the waste allows future generations to make their own choices, but is dependent on the technical ability and preparedness of the society to keep the facility accessible during a long period for inspection and monitoring. It also entails a greater risk of exposure to radiation and requires a long-term organisational effort involving maintenance, data management, monitoring and supervision. In particular in the case of disposal in the deep underground, retrievability will make the construction and operation more complex and requires additional costs.

There might be some conflict between the requirement of retrievability and the requirement to prepare technical provisions for closing a disposal facility. While retrievability demands accessibility of the waste in a repository for a prolonged period –

[32] Lower House, 1992-1993, 23163, no. 1.

until adequate assurance has been obtained that there are no adverse effects associated with geological disposal, or that no more advanced processing methods for the waste have become available – safety requires that the repository is closed as soon as all the waste is emplaced, in order to create an effective barrier from the biosphere. In practice the feasibility of keeping a geological repository accessible for retrieval purposes is restricted to a maximum of a couple of hundred years, depending on the type of host rock[33]. While borehole convergence due to plastic deformation of the host rock is rather limited for granite, repositories in salt and clay, without any supportive measures of the galleries, tend to close around the emplaced waste. Basically in safety studies this plastic behaviour of salt and clay has been advocated as a safety asset because of an enhancement of the containment function of the repository and a facilitation of the heat dissipation to the rock formation. Consequently, the retrieval period should be limited to a realistic length of time. In the Netherlands only salt and clay are available as possible host rock for a geological disposal facility.

A progressive, step-wise closure procedure of the repository is the most likely approach to reconcile both objectives.

Since the Netherlands has adopted the strategy of long-term storage (at least 100 years) in dedicated buildings at the surface, there is no immediate urgency to resolve this matter in the next decade.

14 (iv) Technologies incorporated in the design and construction

For the HABOG technology, see the text under Article 7 (iii). As regards the buildings for the treatment and storage of LILW much experience has been acquired by comparable waste management activities at the previous location in Petten.

ARTICLE 15. ASSESSMENT OF SAFETY OF FACILITIES
Each Contracting Party shall take the appropriate steps to ensure that:
(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;
(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;
(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

15 (i)-(iii) Assessment of Safety

There are no plans yet for the construction of a disposal facility. For the other entries see the text under Article 8.

[33] Retrievable disposal of radioactive waste in the Netherlands, Final report of CORA study, Ministry of Economic Affairs, 2001. (http://appz.ez.nl/publicaties/pdfs/div01.pdf)

ARTICLE 16. OPERATION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

(v) procedures for characterization and segregation of radioactive waste are applied;

(vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

16 (i) Licence to operate

See text under 9 (i).

16 (ii) Operational limits and conditions

See text under 9 (ii).

16 (iii) Operation, maintenance, monitoring, inspection and testing

See text under Article 9 (iii); there are no plans for the construction of a disposal facility.

16 (iv) Engineering and technical support

See text under 9 (iv).

16 (v) Characterization and segregation of radioactive waste.

The radionuclide content of the waste delivered to COVRA is declared and assured by the waste producer. For the LILW four categories are distinguished:

- alpha contaminated waste
- beta/gamma contaminated waste from nuclear power plants
- beta/gamma contaminated waste from producers other than nuclear power plants with a half life longer than 15 years
- beta/gamma contaminated waste from producers other than nuclear power plants with a half life shorter than 15 years

During treatment and conditioning the categories are kept separate.

The price of radioactive waste is a financial incentive to segregate at the production point as much as possible radioactive and non-radioactive materials.

As transferral of the waste to COVRA includes transferral of all liabilities, COVRA performs dose rate measurements before transport on site (there is a relation between dose rate and waste tariff). Furthermore, before processing the waste, random sampling of liquid waste is carried out. In the case that during conditioning the characteristics of the waste turn out to deviate from those provided by the waste producer, COVRA may have to apply for additional processing steps. According to COVRA's accepting conditions, the waste producer will then be charged for all additional costs, creating an incentive for providing the correct data.

16 (vi) Reporting of incidents significant to safety

See text under 9 (v).

16 (vii) Programmes to collect and analyse relevant operating experience

See text under 9 (vi).

16 (viii) Decommissioning plans

See text under 9 (vii).

16 (ix) Closure of a disposal facility

There are no plans for the construction of a disposal facility. Disposal is foreseen more than 100 years from now. The money needed to construct such a facility in the future is gathered in a capital growth fund.

ARTICLE 17. INSTITUTIONAL MEASURES AFTER CLOSURE

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

(i) records of the location, design and inventory of that facility required by the regulatory body are preserved;

(ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required; and

(iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

17 Institutional measures after closure

This article is not applicable, since there are no plans yet for the construction of a (geological) disposal facility.

Section I Transboundary Movement

ARTICLE 27.TRANSBOUNDARY MOVEMENT

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments.

In so doing:

(i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

(ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

(iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;

(iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;

(v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.

2. A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.

3. Nothing in this Convention prejudices or affects:

(i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

(ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;

(iii) the right of a Contracting Party to export its spent fuel for reprocessing;

(iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

27 Transboundary movement

The Netherlands, as a member state of the European Union, has implemented in its national legislation[34] Council Directive nr. 2006/117/Euratom[35]. This directive sets out similar requirements as the ones specified in paragraphs (i)-(v) of this article 27.

Under these regulations imports and exports of radioactive waste require a licence to be issued by the RB (licensing branch pdNIV). Licence applications for a transboundary shipment of radioactive waste should be made to the RB using the standard document laid down in Council Directive nr. 2006/117.

Spent fuel destined for reprocessing is not considered as radioactive waste. However, with a view to the large quantities of radioactive material involved in such transports, these shipments are now also part of Directive 2006/117/Euratom. A transport licence based on the international transport regulations is also required, covering aspects such transport safety, radiation protection, package design approval certificates and physical protection measures.

Paragraph 2 of this article derives from the Antarctic treaty to which the Netherlands is a Contracting Party.

As regards paragraph 3 of this article, the Netherlands has implemented the international agreements on the transport of radioactive materials for the different modes of transport as released by ICAO (air transport), IMO (sea transport), ADR (road transport) and RID (rail transport) and ADNR (transport over inland waterways). The provisions in these agreements are not affected by the Joint Convention[36,37,38,39,40].

[34] Decree on the import, export and transit of radioactive waste and spent fuel, Bulletin of Acts and Decrees, 2009, 168.

[35] Directive Nr. 2006/117/Euratom of the Council of the European Communities of 20 November 2006 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community.

[36] International Civil Aviation Organisation (ICAO), Technical Instructions

[37] International Maritime Organisation (IMO), International Maritime Dangerous Goods Code

[38] Accord Européen relatif au Transport de Marchandises Dangereuses (RID)

[39] Règlement International concernant le Transport des Marchandises Dangereuses par Chemins de Fer

[40] Règlement pour le Transport des Matières Dangereuses sur le Rhin (ADNR)

Section J Disused Sealed Sources

ARTICLE 28. DISUSED SEALED SOURCES

1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.

2. A Contracting Party shall allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

28 Disused sealed sources

Regulation

All import, manufacturing, storage, use, export and disposal of radioactive sources with a radioactivity content in excess of the exemption limits, specified in Annex I of the Euratom Basic Safety Standards[41] and implemented in the national Radiation Protection Decree and subordinate regulation, is subject to availability of a licence. Transport usually does not require a licence but is subject to notification of RVO (an entity of the RB). A licence will only be issued if a qualified expert is available who is knowledgeable with respect to the hazards of ionizing radiation. Persons are considered qualified to use a radioactive source if they have completed a radiation protection course of a level commensurate with the hazard of the source and successfully passed an exam.

Council Directive 2003/122/Euratom[42] aims to further restrict exposure of the population to ionizing radiation from high activity sealed sources (HASS), including orphan sources. The Directive requires that each high activity sealed source is licensed, that it is uniquely identified with a number embossed or stamped on the source and that countries keep a registry of all LHs and sources. It further provides for financial arrangements to ensure that the costs for management of disused sources are covered, in cases where no owner can be identified. The provisions of this Directive are fully implemented in the Radiation Protection Decree and subordinate regulation.

In articles 22 and 33 of the Nuclear Energy Act a mechanism is put in place in which orphan sources, for example lost sources, should be notified to the mayor of the municipality or the city where the sources are found. Subsequently one of the competent inspection services is alerted, which is authorized to impound such source and have it transferred to one of three appointed institutes, which are equipped to store the source. However, most orphan sources are found during routine radiation monitoring of scrap material with portal monitors at scrap yards.

The KFD, the Inspectorate for Social Affairs and Employment (I-SZW) and also the State Supervision of Mines (Sodm) inspect on compliance with legislation and regulations regarding sealed sources. Their scope covers safety and security aspects.

[41] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of health of workers and the general public against the dangers of ionizing radiation, Official Journal of the European Communities, 1996, 39 (L159) 1-114

[42] Council Directive 2003/122/Euratom, of 22 December 2003, on the control of high activity sealed radioactive sources and orphan sources, OJEC, 31/12/03, L346/57

Registering, monitoring and detection of sources

RVO (one of the entities of the RB) maintains a database (TERRA) of the licences of the holders of all sources of ionizing radiation. The information received through the records is added to this database. Furthermore the information received through the records is used for the national source register containing all HASS. Besides the information registered on the record of the source (e.g. data of the LH, identification and features of the source) the national inventory contains a reference to the IAEA source category and the specific use of the source.

Since 2002 large metal recycling companies are obliged to detect all incoming loads of metal scrap on enhanced radiation levels with portal detectors[43]. The purpose is to monitor all scrap at least one time in the Netherlands. In this way it should be prevented that an orphan source reaches a foundry and is melted.

There are no radiation monitors at points of entry at the borders of the Netherlands to detect orphan sources. However, since 2005 in total 40 portal monitors have been installed at container terminals in the Rotterdam harbour. These monitors were installed on the basis of a Mutual Declaration of Principles between the Netherlands and the United States of America to monitor containers for the purpose of detecting and interdicting illicit trafficking of nuclear and other radioactive material. In airports handheld radiation monitors are available.

Orphan sealed sources are not frequently found in the Netherlands. In recent years there were no reports of found or lost high activity disused sealed sources. Radioactivity in metal scrap occurs rather frequently and is transferred to COVRA on a routine basis.

Waste management of disused sources

With respect to disused sources the policy gives priority to the reuse of the source. When this is not possible, the alternative preferred is to return the disused source to the supplier. Treating the disused source as radioactive waste, by transferring it to a licensed waste treatment or storage facility, is considered to be the final alternative. The LH is allowed to store radioactive waste onto its premises for the period of a maximum of 2 years after cessation of the use. After this period, the radioactive waste must be transferred to COVRA.

Sources, as any other LILW, are destined for disposal in an underground repository in due time. Regular inspections by the official inspection services ensure that individual sources can be tracked during their whole useful life by following the chain of records.

Council Directive 2006/117/Euratom[44] on transboundary shipments of radioactive waste facilitates return of spent sealed sources to the manufacturer by excluding such shipments from the scope of application of the directive. However, such shipments of sources is regulated by Council Regulation (Euratom) No 1493/93 of 8 June 1993 on shipments of radioactive substances between Member States.

[43] Decree on the detection of scrap material contaminated with radioactivity, Bulletin of Acts and Decrees 2002, 407

[44] Directive Nr. 2006/117/Euratom of the Council of the European Communities of 20 November 2006 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community

Section K General Efforts to Improve Safety

Maintenance of nuclear competence at COVRA

A concern at the fourth Review Conference was the identification of the difficulty to maintain nuclear competence for a period of at least 100 years, since Dutch radioactive waste policy is based on the concept of long-term interim storage. It was noted that the continuity of knowledge during this storage period may require that expertise will have to be hired outside the country. Another point is to ensure the preservation of the information on the stored waste and its history for a period of at least 100 years.

Ensuring the availability of qualified staff through the years is always a challenge in countries with a small nuclear programme. As COVRA is the only organisation in the Netherlands licensed to manage and store radioactive waste and spent fuel, it will have to preserve at least a minimum of qualified staff for the foreseen storage period of 100 years. Additional expertise could be hired from abroad.

The preservation of information on the stored waste and its history is ensured by technical means: all data are preserved in a double archive, using both digital as well as conventional paper data storage. A distinction is made between the short-term archives (<15 years) and the long-term archives (>15 years). For the long-term archive additional measures are taken. The digital information is stored in two different buildings and a procedure exists to update this information at regular intervals. Paper information carriers are printed on certified durable paper and ink and stored in a conditioned room.

Maintenance of nuclear competence at Regulatory Body

The main themes addressed at the fourth Review Conference have been addressed in the Introduction to the present report. An important theme is the supply in adequate numbers, suitably qualified and experienced staff for the RB. Recently the RB staffing has been strengthened and the staff receives dedicated training. The establishment of a new RB organisation uniting various entities constituting the present RB, with guaranties for its robustness, will aid further to the competence at the RB.

Section L Annexes

Annex 1 Interim Waste Storage Facilities

COVRA has a site available of about 25 ha at the industrial area Vlissingen-Oost. Information on the siting process, licensing, construction and practical experience can be found in the literature and in the NEWMDB of the IAEA. Long-term storage was taken into account in the design of the facilities. Al storage facilities are modular. The available site offers enough space for the waste expected to be produced in the next hundred years. A layout of the COVRA facilities as present today, is given in Figure A.1.

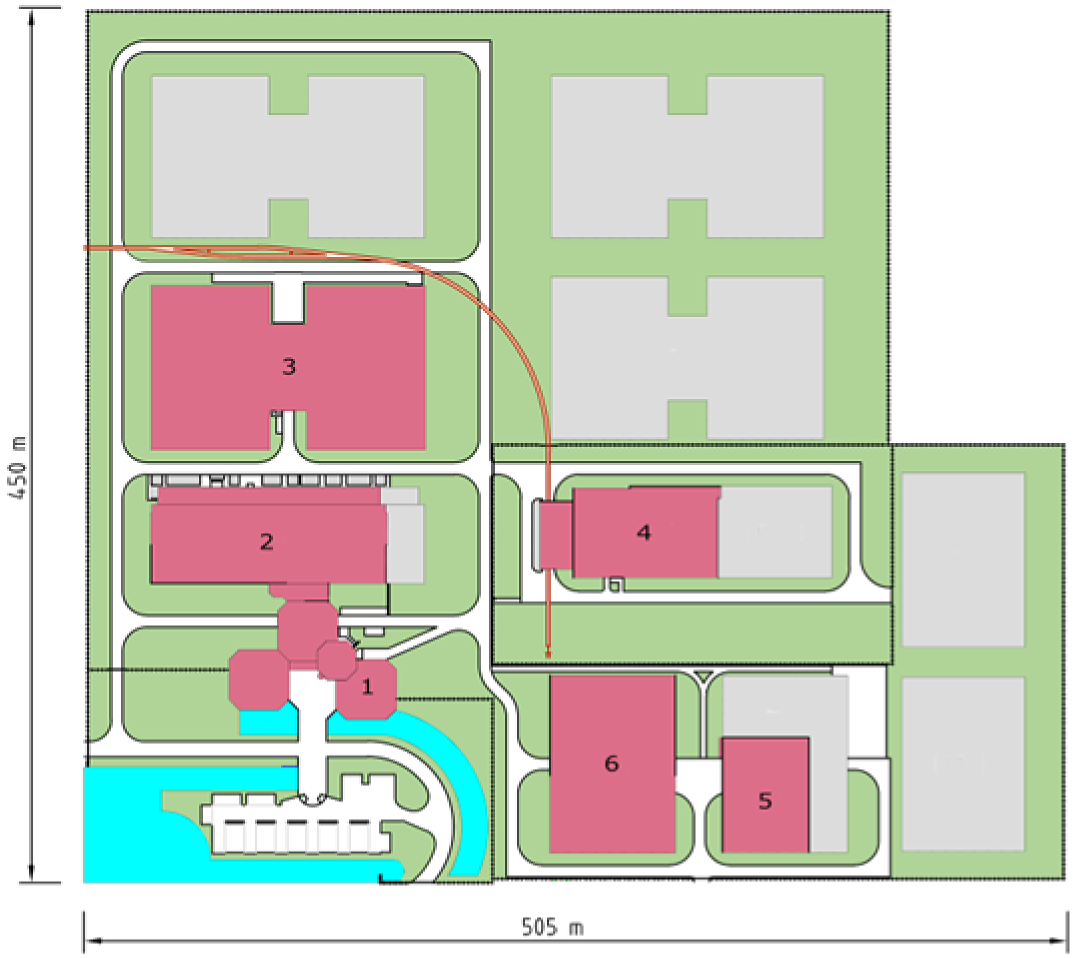

Figure A.1. Layout of the COVRA facilities. In grey future expansions of the modular buildings are indicated.

1 – office building and exhibition centre;

2 – building for the treatment of low- and intermediate-level waste;

3 – storage building for conditioned low- and intermediate-level waste;

4 – storage building for high-level waste;

5 – storage building for low-level waste from the ore processing industry;

6 – storage building for depleted uranium.

All storage facilities are modular buildings. The storage building for low- and intermediate-level waste is H-shaped (nr. 3 in the figure) and it consists of a central reception bay surrounded by four storage modules. Each storage module presents a storage capacity for ten to fifteen years of waste production at the present rate. In total 16 storage modules for low- and intermediate-level waste can be constructed which represents at least some 160 years of waste production.

Of the storage building for NORM waste (nr 5 in the figure), only one third of the full building is in operation right now. One more building of approximately the same size could be constructed in the future. Of the storage building for depleted uranium waste (nr 6 in the figure), the full building is in operation right now but only half of the capacity is used. One or possibly two buildings will be used for the storage of depleted uranium.

It is expected that the potential storage capacity will be sufficient for hundred years.

The storage building for high-level waste (nr 4 in the figure) can be doubled in capacity. The present capacity is sufficient for the existing nuclear programme until about 2015.

Since all wastes will be stored for a period of at least 100 years, this has to be taken into account in the design of the storage.

Low- and intermediate-level waste

Because of the small volume of waste and the large variety of waste forms it is important to centralise installations and know-how. The purpose of the treatment is to produce a waste package that is expected to last for at least 100 years and that can be handled after that period. The package should therefore:

- provide an uniform and stable containment;
- avoid possible spreading of radionuclides into the environment;
- lower the radiation dose of handling to acceptable levels;
- allow simple repair and monitoring;
- reduce the volume of the waste;
- be acceptable for final disposal.

For the low- and intermediate-level waste the desired package that meets the above criteria is a cemented waste package. The size of the resulting package is standardised and limited in size in order to ease later handling. Generally, packages with a final volume of 200 litre or 1000 litre are produced. The 200-litre drum is a galvanised steel drum with inside a layer of five centimetre of clean, uncontaminated concrete, embedding the waste. The 1000 litre packages are full concrete packages wherein a cemented waste form is present. In each package there is at least as much cement as waste volume. 200 litre packages with higher dose rate can be placed in removable concrete shielding containers of the same size as the 100-litre containers.

Figure A.2. The storage of low- and intermediate-level waste

Figure A.3. The storage of radioactive calcinate from phosphor production

The conditioned waste packages are stored in a dedicated storage building (LOG). Simplicity, but robustness was leading in the design. The storage building is constructed from prefabricated concrete elements. The outer shell, roof and walls, can be replaced while keeping the waste indoors. The storage building has a central reception area that is connected to four storage modules. Each module can accommodate ten years waste production. Technical provisions inside the modules are minimal: only supply of electricity and light. Both can easily be replaced. All other technical provisions are placed in the reception area. With mobile equipment the air humidity in the storage building is kept around 60%. Waste packages are stacked inside with forklift trucks. Waste packages are placed five rows thick and nine positions high, leaving open inspection corridors. In a group of five rows of packages, higher dose rate packages are placed in the middle in order to reduce dose to the workers and the environment (see Figure A.2). The exact position of each individual package is administrated. All containers must be free of outside contamination according to normal transport requirements. As a result contamination is not present inside the building. Nor fire detection or fire fighting equipment is present in the storage modules, since burnable materials are almost absent. Floor drainage has been judged to be useless and weakening the structure. The floor has upstanding edges that prevents water entering the building.

NORM and depleted U

The NORM (Naturally Occurring Radioactive Material) waste stored is a calcined product resulting from the production of phosphor in a dry/high temperature process. It is a stable product that does not need further conditioning to assure safe storage. Polonium-, lead- and bismuth-210, relatively short lived but highly radiotoxic nuclides, are concentrated in this waste. Radiation levels from these alpha-emitting radionuclides are very low at the outside of a package. After decay of the radionuclides the material will be cleared and brought outside the nuclear domain. Economics played an important role in the implementation of the storage solution. The calcinate produced at the phosphor plant is dried at the plant and collected in a specially designed 20-ft container. There are three filling positions in the roof of the container that can be closed with a sealed lid. Inside the container a polyethylene bag serves as a liner. The in- and outside of the container is preserved with high quality paint. The container can be filled with 30 tonnes of material. These containers are stacked four high in the container storage building (see Figure A.3). Inspection corridors are kept open, as well as an opening to retrieve the containers firstly stored.

The container storage building is a galvanised steel construction frame with steel insulation panels. High quality criteria were set for the construction and materials in order to meet 150 years lifetime with minimum maintenance. This building also, can be modularly expanded. Again, technical provisions inside the building are minimal. Per storage module an overhead crane is present. The very low radiation doses in the facility allow all maintenance inside. With mobile equipment the air humidity in the storage building is kept around 50%. All containers must be free of outside contamination according to normal transport requirements. So inside the building contamination is not present.

The solution for depleted uranium from enrichment activities, is similar to the one for the calcinate: storage of unconditioned material in larger containers, in this case storage of U3O8 in DV70 containers. For depleted U_3O_8 the argument to wait for decay to clearance levels is not applicable. The argument not to embed the material in a cement matrix is the potential value of the material as a future resource. If reuse does not take place in the far future and the decision is taken to dispose of the material, this can be done according to then applicable standards. Money for this treatment and for the final disposal is set aside in the capital growth fund in the same way as is done for all other waste stored at COVRA.

The storage building is a simple concrete construction with insulation panels. A concrete structure is used, because some shielding is required here. The building can modularly be expanded and per storage module an overhead crane is present. For maintenance the overhead crane can be brought to a central reception area that is shielded from the storage module. The same philosophy is followed in this storage building as in the other storage buildings: technical provisions inside the building are minimal. With mobile equipment the air humidity in the storage building is kept around 50%. As all containers must be free of outside contamination according to normal transport requirements, no contamination is present inside the building.

High-level waste

In the seventies it has been decided to reprocess all SF of the nuclear power plants in facilities abroad. Vitrified waste and compacted hulls and end caps are and will be returned to the Netherlands. The research reactors as well as the molybdenum production facility in the Netherlands produce SF and other high-level waste. A win-win situation could be obtained by combining the needs of the nuclear power sector with the needs of others. A packaging and storage facility is in operation for high-level reprocessing waste, SF from research reactors and spent uranium targets from molybdenum production. This facility, called HABOG by its acronym, is a modular vault with a passive cooling system. Heat-generating waste is stored in vertical wells, filled with a noble gas in order to prevent corrosion over the long storage period considered. Air convection brings cold air in that cools the wells at the outside and is discharged as warmer air via the ventilation stacks. Contamination of the air is not possible.

Figure A.4. Emplacement of the wells during construction

Figure A.5. Worker in the concrete at work in a 1.7 meter thick outer wall

The choice of this system that has no mechanical components is a direct result of the choice for long-term storage. The design of the concrete structure was based on a lifetime of at least 100 years. The facility has further been designed such that all events with a frequency of occurrence of 10^{-6} per year are taken into account and do not create any radiological risk to the outside world. There is spare capacity available to empty each storage module in order to allow for human inspection or repair. Also repacking is possible within the facility, including space to store the larger over packs. SNF from research reactors are packaged into stainless steel canisters compatible with the storage wells. These canisters are welded tight and filled with helium in order to check the weld and to create a non-corrosive environment for the waste. All waste packages stored are free of contamination on the outside. In the storage areas no mechanical or electrical equipment is present. Maintenance, repair or even replacement can be done in a radiation-free environment.

See Figures A.4 and A.5 for photos of the construction of HABOG and Figure A.6 for the present appearance of HABOG.

Figure A.6. HABOG

Annex 2 Communication practice of COVRA

Transparency and communication are an integrated part of the operations of the radioactive waste management organisation COVRA. Because of the long-term activities, COVRA can only function effectively when it has a good, open and transparent relationship with the public and particularly with the local population. When COVRA in 1992 constructed its facilities at a new site, it took it as a challenge to build a good relationship with the local population.

From the beginning attention was paid to psychological and emotional factors in the design of the technical facilities. All the installations have been designed so that visitors can have a look at the work as it is done. Creating a good working atmosphere open to visitors was aimed at. The idea was not to create just a visitors centre at the site, but to make the site and all of its facilities the visitors centre.

During construction of HABOG - an interim storage for high-level radioactive waste - the idea was born to take this one step further, to do something really special. Discussions with an artist, William Verstraeten, resulted in a provocative idea. The artist launched the idea to integrate the HLW building, HABOG, into an artistical concept. He created ‘Metamorphosis’.

HABOG features a bright orange exterior and the prominent display of Albert Einstein's equation $E=mc^2$ and Max Planck's $E=h\nu$. Designed to last for up to 300 years, it contains the waste resulting from the reprocessing of the spent nuclear fuel from the Netherlands' nuclear power stations Borssele and Dodewaard as well as spent fuel from research reactors and the spent uranium targets of molybdenum production.

The waste inside HABOG is planned to remain there for at least 100 years, during which time its radioactivity will decrease through decay. This process is symbolised by the colour of the building's exterior, which is to be repainted every 20 years in lighter and lighter shades of orange until reaching white. The orange colour was chosen because it is halfway between red and green, colours that usually symbolise respectively danger and safety.

HABOG is more than an interim storage, it is a communication tool. It helps to explain the concept of radioactivity in simple not technical way. It is an ‘attraction’ that draws people to the COVRA facilities, people from the region, but also from all over the country and abroad. It provokes questions and stimulates discussion about radioactive waste and its management. People remember the story of the building, the changing colour which helps them to understand the process of decay and the safety of radioactive waste storage.

Another way to start the dialogue and communication about long-term storage, showing people that we have a very long history of preserving things, often things that are far more difficult to store than immobilized waste. Ask people how long we should preserve our cultural heritage such as the paintings of Rembrandt or Van Gogh. The answer is generally: “for ever”. The link between the long-term preservation of art and the management of radioactive waste helps people to visualize and trust the concept of long-term management. Interestingly, a real connection with the cultural heritage could be created. Museums in the region where COVRA is situated, have endured shortage of storage capacity for the artefacts that are not on exhibit. This represents generally some 90% of their collection. Looking for suitable storage space, the museums and COVRA found each other. The conditioned COVRA storage buildings for low and intermediate level waste have enough unused space to store the museum artefacts. This space is available as result of the robust construction of the storage building and this space cannot be used for the radioactive waste itself. The climate conditions are favourable because there are only gradual temperature changes and an air humidity under 60%. In 2009 the storage space has been offered for free to the museums in a contract for 100 years. Such a long-term contract is unique even for museums. The National Museum of the Netherlands (the Rijksmuseum) for instance, where works by Rembrandt can be seen, only has a 40-year contract with a storage depot.

The new storage buildings planned for storage of depleted uranium as well as the extension of the HLW building offer further opportunities to interest the public in our work. To start a dialogue. And to give a positive image of radioactive waste. This is why we at COVRA design our buildings to be a thing of beauty. To use our buildings to communicate and tell vivid stories that appeal to emotions. Emotions are subconscious and they will leave a trace long after the words have been forgotten. Art and cultural heritage give such stories and provide compelling metaphors for radioactive waste. Now that the storage capacity both for depleted uranium as well as for high level waste has to be extended, art will be included again. The storage facility for depleted uranium will become a sundial.

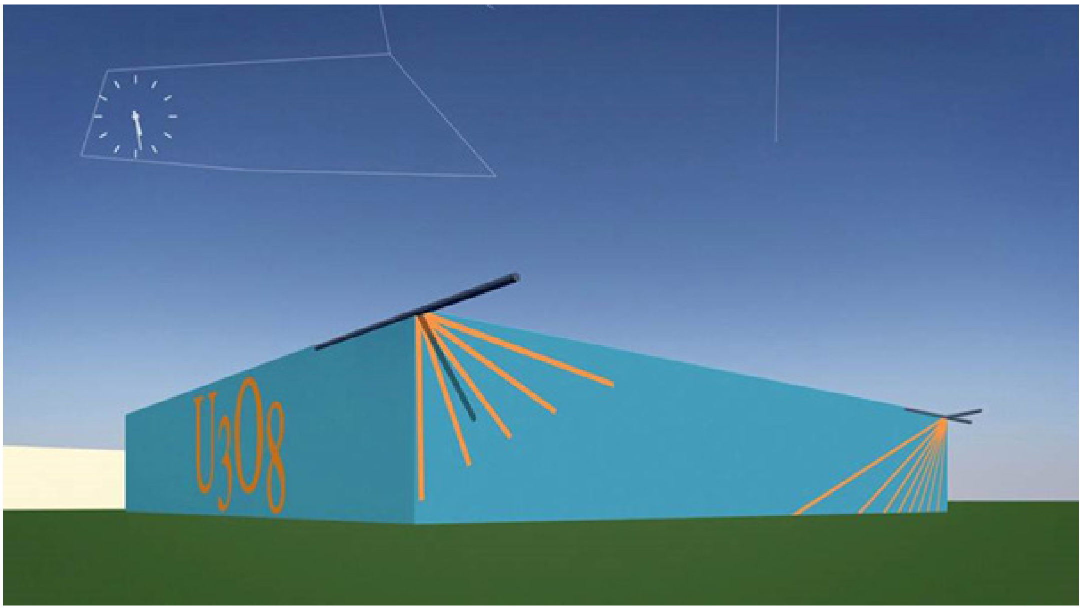

Figure A.7 The second depleted uranium building is the largest sundial of Europe

The extension of HABOG will create a special event only twice a year. The sun will perform a visual play with the building in the same tradition as in Stonehenge or as in the pyramid of Quetzalcoatl in Mexico.

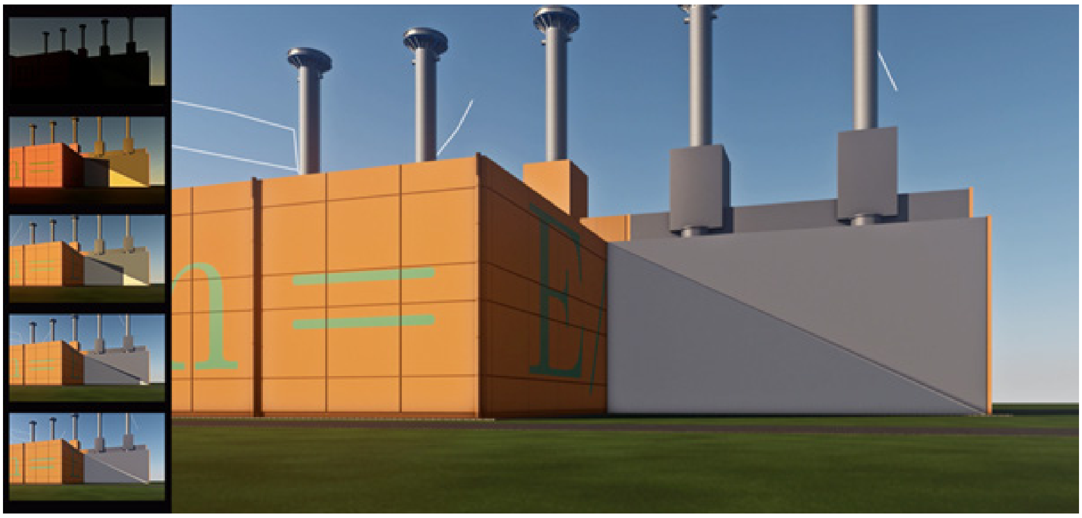

Figure A.8 Visual play of sun on the extension of HABOG occurring twice a year

International recognition

In the 2009 IAEA waste safety appraisal of COVRA, the communication policy of COVRA was recorded as one of its good practices. It was concluded that inviting people to visit the site and presenting its activities through art to facilitate the communication of radioactive waste management activities to the public has lead to increasing transparency and confidence building of the public. At the ENEF Prague Plenary meeting May 2011 two years later, the communication policy was also identified as one of the good practices on information, communication, participation and decision-making in nuclear matters.

In 2010, COVRA won an award presented by the Italian foundation Pimby (‘Please in my backyard’) for its transparent communication about radioactive waste management to the general public.

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