Ministry of Infrastructure and the Environment

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 Sixth Review Meeting

The Hague, October 2017

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LIST OF SYMBOLS AND ABBREVIATIONS

Acronym	Full term	Translation or explanation (in brackets)
ANVS	Autoriteit Nucleaire Veiligheid en Stralingsbescherming	Authority for Nuclear Safety and Radiation Protection
Awb	Algemene wet bestuursrecht	General Administrative Act
Bkse	Besluit kerninstallaties, splijtstoffen en ertsen	Nuclear Installations, Fissionable Materials and Ores Decree
Bs	Besluit stralingsbescherming	Radiation Protection Decree
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
ECN	Energieonderzoek Centrum Nederland	Netherlands Energy Research Foundation
EIA	Environmental Impact Assessment	
EZ	(Ministerie van) Economische Zaken	(Ministry of) Economic Affairs
EPA-n	Eenheid Planning en Advies nucleair	National Nuclear Assessment Team
EPZ	N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland	(Operator of Borssele NPP)
GKN	Gemeenschappelijke Kernenergiecentrale Nederland	(Operator of Dodewaard NPP)
GRS	Gesellschaft für Anlagen- und Reaktorsicherheit	
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	
I&M	(Ministerie van) Infrastructuur en Milieu	(Ministry) of Infrastructure and the Environment
ILT	'Inspectie Leefomgeving en Transport'	Inspectorate of the ministry of

Acronym	Full term	Translation or explanation (in brackets)
		I&M.
IRRS	Integrated Regulatory Review Service	
ISO	International Standards Organisation	
JRC	Joint Research Centre of the European Communities	
Kew	Kernenergiewet	Nuclear Energy Act
LEU	Low Enriched Uranium	
LFR	Lage Flux Reactor	Low Flux Reactor
LH	Licence Holder	
LILW	Low- and Intermediate-Level Waste	
LOG	Laagradioactief afval Opslag Gebouw	Low-level Waste Storage Building
MOX	Mengoxide	Mixed Oxide
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	
NORM	Naturally Occurring Radioactive Material	
NPP	Nuclear Power Plant	
NRG	Nuclear Research & consultancy Group	
NVR	Nucleaire VeiligheidsRegels	Nuclear safety rules (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)
RIVM	Rijks Instituut voor Volksgezondheid en Milieu	National Institute of Public Health and the Environment
RR	Research Reactor	
SAR	Safety Analysis Report	
SF	Spent Fuel	
SZW	(Ministerie van) Sociale Zaken en Werkgelegenheid	(Ministry of) Social Affairs and Employment
VOG	Verarmd uranium Opslag Gebouw	Storage Building for Depleted Uranium

Acronym	Full term	Translation or explanation (in brackets)
Wm	Wet Milieubeheer	Environmental Protection Act
WSF	Waste Storage Facility	Waste storage building for legacy waste in Petten

Section A Introduction

Purpose of the national Joint Convention 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 (hereafter: Joint Convention or JC), 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 sixth in its series. It describes how the Netherlands meets the obligations of each of the articles established by the Joint Convention.

The information provided by the present report applies to the situation of August 1st 2017 unless explicitly specified otherwise.

Structure of the national report

The national report for the Joint Convention follows closely the structure as suggested in INFCIRC/604/Rev.4, "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 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

Relationship between this national report and other national reports[1]

- In the European Union, Council Directive 2011/70/Euratom (hereafter: the Directive) establishes a community framework for the safe management of spent fuel and radioactive wastes. Article 11 of the Directive obliges EU Member States to publish a 'national programme for the management of spent fuel and radioactive waste' (hereafter: national programme) which describes in detail the policy regarding the management of spent fuel and radioactive waste now and in the future. The Netherlands published its national programme in 2016.

[1] All national reports can be found at the website of the ANVS, http://www.anvs.nl

- In 2016, the Netherlands published the 'National Report for the Council Directive 2011/70/Euratom', which demonstrates how the Netherlands complies with the obligations arising from the Directive.
- In 2016, the Netherlands also published its national report for the Convention on Nuclear Safety (CNS).

National nuclear programme

In the Netherlands there is one nuclear power plant (NPP) in operation: the Borssele Pressurized Water Reactor (Siemens/KWU design, net electrical output 485 MW_e), operated by N. V. Elektriciteits-Produktiemaatschappij Zuid-Nederland (EPZ). Another NPP, the Dodewaard Boiling Water Reactor (GE design, 60 MW_e), operated by Gemeenschappelijke Kerncentrale Nederland (GKN), was shutdown in 1997 and is now in 'Safe Enclosure', a stage of decommissioning.

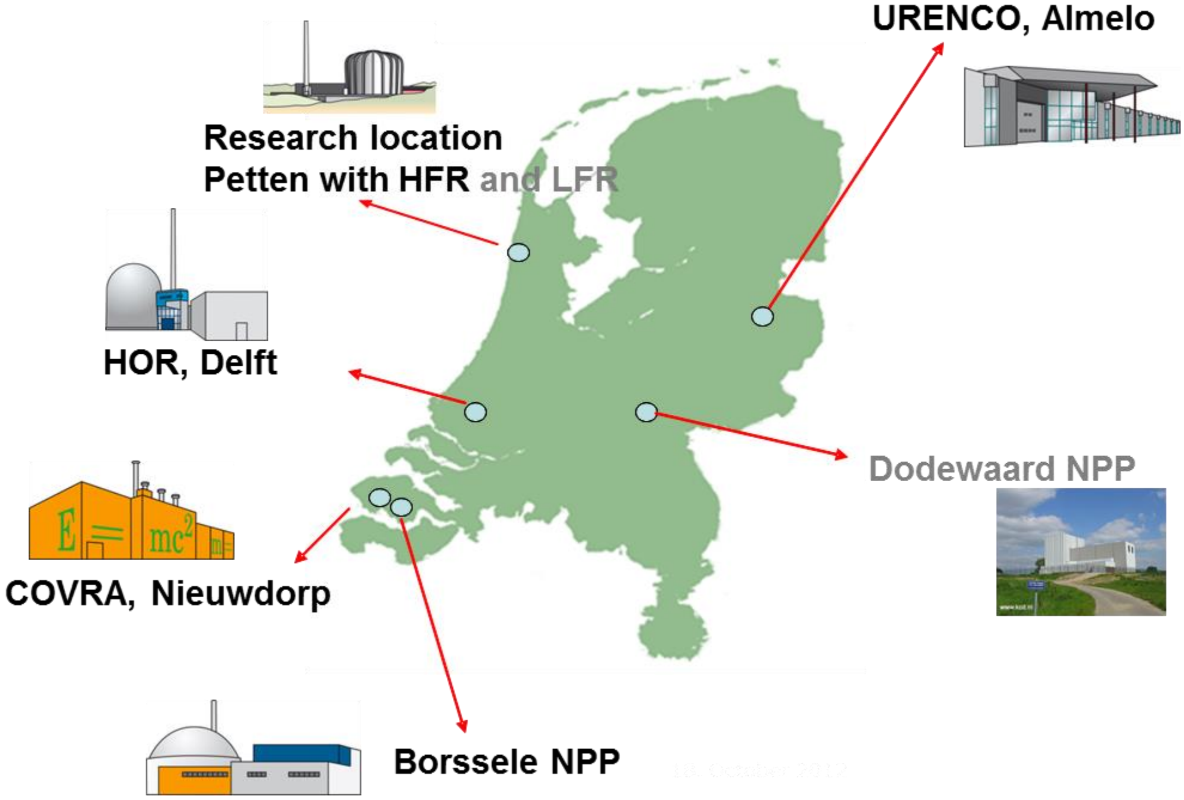

Figure 1 Locations of nuclear installations in the Netherlands

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), and the Hoger Onderwijs Reactor (HOR, 2 MW_{th}) at the Reactor Institute Delft (RID), 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 ongoing and spent fuel has been removed.

The facilities for uranium enrichment of Urenco Netherlands are located in Almelo. Licensed capacity is currently 6200 tSW/a.

The facilities of the Central Organisation for Radioactive Waste (COVRA), the national Waste Management Organisation (WMO), are located at one site in Nieuwdorp. COVRA has facilities for the interim storage of 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.

Details on the national nuclear programme of the Netherlands can be found in the national report for the CNS.

Sources of spent fuel and radioactive waste in the Netherlands

The spent fuel and radioactive waste are generated by Licence Holders. The waste produced can be divided into six sectors: nuclear, industry, medical, NORM[2] industry, research and miscellaneous. All licensees in the Netherlands are required to offer their radioactive waste to COVRA. NORM waste with an activity concentration of up to ten times higher than the clearance levels need not be entrusted to COVRA, but is safely managed as very low level waste at designated landfills.

An inventory of SF and radioactive waste can be found in section D.

The policy in respect of the safe management of spent fuel and radioactive waste

The policy is briefly summarized below. More details can be found in section B.

Policy on radioactive waste and spent fuel and links to other policy fields

The policy on radioactive waste and spent fuel is part of the policy on radiation protection, which protects individuals, society and the environment against the risks of exposure to ionising radiation. Exposure to radiation must be justified, as low as reasonably achievable (ALARA) and must remain within specified thresholds. Anyone using ionising radiation bears prime responsibility for its use. The same principles are applied to the management of radioactive waste.

The policy applies a graded approach; the greater the risk, the stricter the regime. For example, the requirements imposed on activities involving spent fuel are stricter than for activities involving other radioactive substances.

The policy on radioactive waste ties in with the policy for conventional waste. The policy strives to close raw materials cycles as far as possible, with priority to be given to the most environmentally friendly possible processing methods. In the policy on radioactive waste, the same preferred order for processing is assumed as for conventional waste: prevention, reuse, and finally safe management of remaining waste substances.

Furthermore, as with management of conventional waste, the IBC-principle[3] is applied to the management of radioactive waste: isolate, manage and control.

Policy principles

- The policy is aimed at minimising the waste flows. Prevention of waste production, reuse and using radioactive decay are successful policy instruments.
- Safe management now and in the future is a key element. During aboveground storage at COVRA, the waste is safely managed. Around 2130 geological disposal is envisaged. During the operation of the disposal facility the waste must be retrievable.
- Undue burdens on future generations have to be avoided. Generations that have profited from a specific application of radioactivity, such as nuclear power of medical isotopes, must themselves bear the burdens for the managing the waste produced in those activities.
- Causers of radioactive waste bear the costs for the management of the waste. In respect of all costs involved in the management of the radioactive waste the ‘polluter pays’ principle will apply.

[2] NORM, Naturally Occuring Radioactive Material

[3] IBC, Dutch acronym meaning: ‘Isoleren, Beheren en Controleren, i.e. isolate, manage and control.

Policy on reprocessing of spent fuel from the nuclear power plant in Borssele

Government policy in respect of the reprocessing of SF in principle leaves the choice of whether or not to reprocess to the operator of the nuclear power plant. In the past the operators of NPPs have decided in favour of reprocessing their SF for economic reasons, reuse of plutonium and reduction of the waste volume.

Policy on long-term management of radioactive waste and spent fuel

The current policy assumes that the radioactive waste and spent fuel will be stored in specially designed buildings (at COVRA) 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 the disposal facility will be ready to receive radioactive wastes around 2130. The definitive decision on disposal will be made around 2100. Up to that moment, society may also opt for another management option, depending on insights at that moment, and assuming that other alternatives are possible at that time.

To achieve actual disposal, both a national and an international line are being followed ('dual strategy'). Within this strategy, a national route towards disposal will be elaborated. At the same time the possibility of international collaboration regarding radioactive waste management with other countries will not be excluded. The dual strategy makes it possible to respond appropriately to possible international initiatives regarding management of radioactive waste.

The design of the disposal facility must allow the possibility of retrieval of the waste (via the existing shaft) during the operation of the disposal facility.

The practice of the management of spent fuel and radioactive waste in the Netherlands and the implementing organisations

Current practice on reprocessing

The operator of the nuclear power plant in Borssele has entered into reprocessing contracts for all spent fuel which will be produced up to the end of the operating period of the power plant. In 2012, the Republic of France and the Kingdom of the Netherlands signed a treaty that regulates the reception and reprocessing of Dutch spent fuel by Areva NC in France, and the return to the Netherlands of the radioactive residues from reprocessing.

Spent fuel from the research reactors will not be reprocessed, but will be directly transported to COVRA.

Current practice COVRA

The nuclear programme of the Netherlands is relatively small, but diverse. The total quantities of spent fuel and radioactive waste are modest. By centralizing most of the radioactive waste management activities in the Netherlands in one national WMO (i.e. COVRA), and at one site, benefits of economies of scale are optimized. 100% of the shares in COVRA are held by the State, and this aids to guarantee a system of long-term institutional control.

Nuclear installations do not have their own (long-term) waste storage facilities. The storage capacity at COVRA has been dimensioned to handle the expected Dutch demand for storage capacity till at least the year 2130.

Another task of COVRA is to generate the funds to create capital provisions to cover the cost for both long-term aboveground storage and for the implementation and operation of (geological) disposal facility for the waste.

COVRA also coordinates the current research programme about geological disposal OPERA[4]. The results of OPERA are expected to be available around the end of 2017.

[4] Dutch: Onderzoeksprogramma Eindberging Radioactief Afval, i.e. research programme on the disposal of radioactive wastes

The COVRA site is approximately 25 hectares. On this site, COVRA has various waste processing and storage facilities for radioactive waste and spent fuel. The 'HABOG facility' was built for the storage of high level radioactive waste. The building is resistant to the most extreme conceivable external occurrences. It is a modular storage building with a passive cooling system. Currently extension of HABOG is ongoing.

COVRA offers the possibility to store materials that need a period longer than two years[5] to decay to below the clearance levels (decay storage). During a period of not more than 50 years, without being processed, materials from the dismantling of large fixed installations can be stored at COVRA as well.

History of the current practice

Originally the Dutch radioactive waste storage facility was located at the Research Location Petten (1985 – 1992). This explains why a certain amount of 'legacy' radioactive waste is still stored at the Research Location Petten in the Waste Storage Facility (WSF). Currently, the low-level waste-part of the legacy 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 2022.

The regulatory framework – recent developments

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.

Since the publication of the 5th national report to the Joint Convention in 2014, some changes were included in the Nuclear Energy Act. A prominent change established that the Minister of Infrastructure and the Environment became the principal responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the Regulatory Body - the responsible Minister used to be the Minister of Economic Affairs. This change took effect by a Royal Decree of May 1st 2015. Another update in August 2017 of the Act (and subordinate regulation) legally established the new Authority for Nuclear Safety and Radiation Protection, the ANVS[6] as an independent administrative authority (Dutch acronym: ZBO[7]). For more information, refer to the section on the RB below.

Some Decrees associated with the Nuclear Energy Act contain 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 ongoing substantial update of the Decree on Radiation Protection (Bs) because of the transposition of Council Directive 2013/59/Euratom (BSS) laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation.

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 safety regulations are referred to as the Nuclear Safety Rules (Dutch: 'Nucleaire VeiligheidsRegels', NVRs). NVRs are based on IAEA Safety Guides, and in their numbering, the numbers of the corresponding IAEA guides are referenced.

Because of the diversity of the small nuclear programme 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 and VOBK can be referenced as well as other nuclear codes and standards.

[5] This is a period during which the LH is permitted to store waste materials with a half-life of not more than 100 days at its own facilities, to allow that waste decay to non-radioactive material.

[6] Dutch: 'Autoriteit Nucleaire Veiligheid en Stralingsbescherming', ANVS

[7] ZBO, 'Zelfstandig Bestuurs Orgaan' or independent administrative authority.

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

The competent regulatory authority or 'Regulatory Body' involved in the responsible and safe management of spent fuel and radioactive waste in the Netherlands

The 'Regulatory Body' (RB) is the authority designated by the government as having legal authority for conducting the regulatory processes, including issuing authorizations, supervision and enforcement. In 2015 the various entities that formerly constituted the RB, have largely merged into the one entity, the ANVS.On August 1st 2017 the ANVS attained the formal status of an independent administrative body (ZBO), when the necessary amendment of the Nuclear Energy Act and subordinate regulation took effect.

The ANVS brings together expertise in the fields of nuclear safety and radiation protection, as well as security and safeguards. For each of these subjects, the ANVS is focused on preparing policy, legislation and regulations, the awarding of licences, supervision and enforcement and (public) information. The ANVS contributes to safety studies and ensures that the Netherlands is well prepared for any radioaction incidents.

The ANVS is independent in its regulatory activities on radiation protection, nuclear safety and security in the Netherlands, but the Minister of Infrastructure and the Environment is politically responsible for its functioning.

The tasks related to safe management of spent fuel and radioactive waste are within the scope of the ANVS. Therefore this report often will refer to the ANVS as the RB.

More information and expected future developments of the RB are described in Section E in the text on Article 20, as far as it concerns developments in associated enabling regulation.

Summary of major developments since submission of the fifth national report

- Notable is the ongoing substantial update of the Decree on Radiation Protection (Bs) because of the transposition of (European) Council Directive 2013/59/Euratom[8] (BSS).Some Decrees associated with the Nuclear Energy Act contain additional regulations related to the use of nuclear technology and materials. These decrees continue to be updated in the light of ongoing developments.
- All countries of the European Union (EU) have to comply with the requirements of European Council Directive 2011/70/Euratom, establishing a framework for the responsible and safe management of spent fuel and radioactive waste. As part of its obligations under the Directive, the Netherlands published (1) in May 2016 a National Report that shows how the Netherlands meets the requirements of each of the articles of this Directive, and (2) in June 2016 its 'National Programme for the management of radioactive waste and spent fuel'.
- The interim storage facility of COVRA for high-level waste (HABOG) will be extended.
- A new storage building for depleted uranium (VOG-2) at COVRA was completed. During the 2017 PIME[9] conference, the building was the venue of the conference.

[8] Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

[9] Public Information Materials Exchange, PIME

Update on the main challenges and recommendations from the fifth Review Conference

During the fifth Joint Convention Review Meeting, several challenges for the Dutch RB were identified:

1. *Ensuring the availability of qualified and experienced staff at the waste management organizations and the Regulatory Body*

The Netherlands have merged several entities of the RB into the ANVS which constitutes a large efficiency and effectiviness improvement for the development and maintenance of competences for most disciplines.

Various tasks that in the past were performed by different Ministries are now taken care of by ANVS. The ANVS faces staffing challenges because of the accumulation of many regulatory activies. In fact it has more tasks than the combined past entities of the RB. In 2014 the IAEA recommended in its IRRS[10]-report to the Government of the Netherlands to make a futher analysis of the manpower situation. Staff has grown the past few years from about 90 FTE to about 130 FTE, to be further increased to 141, including the two members of the board.

For the disciplines where the expertise is lacking or not yet fully developed or when temporary more capacity is needed, the authority has a budget for insourcing external specialists, TSOs or other consultancy organisations (such as NRG). Both GRS and NRG have a framework contract with the ANVS for the provision of services.

Since 2016 ANVS has a knowledge management coordinator. A strategic HRM-plan is under development, including related training and qualification programmes. Representatives of the authority regularly participate in international missions (under the auspices of the IAEA) in other countries. This is one way in which knowledge and understanding is broadened among the staff of the authority.

A number of tasks of the ANVS are entrusted to the National Institute for Public Health and the Environment (RIVM). These are above all specific tasks relating to radiation protection, such as nuclear accident prevention, implementing specific measurements (in the radiation laboratory) and policy support.

The division of the RIVM involved in these radiation tasks is not part of the ANVS, giving the RIVM the position of an independent and scientific knowledge institute. The ANVS holds solid and long-term ties with the RIVM, and as such is a 'regular client' of the RIVM. Framework agreements and protocols have been drawn up for this purpose. The tasks of the RIVM/Radiation undertaken for the ANVS are covered by a single RIVM programme. Supervision on the execution of the RIVM programme is the responsibility of the board of the ANVS.

In the Netherlands, the RID/R3 group at the University of Technology in Delft and the Nuclear Research & Consultancy Group (NRG) in Petten and Arnhem are the best known providers of training in nuclear technology, nuclear safety and radiation protection. They provide educational services to both government and the private sector.

The ANVS also profits from internationally operating organisations with facilities for education and training. Examples include the German GRS, ENSTI (training institute at ETSON), IAEA, OECD/NEA and others.

The Ministerial Regulation on nuclear safety, in implementation of European Directive no. 2009/71, specifies in Article 6 that the licence holder must have a training plan for education and training of the staff, with a view to the nuclear safety of the nuclear installations under its management.

COVRA has drawn up a Staff Qualification Plan that is part of the generic 'Integrated Management System'. This plan describes the numerous aspects of human resources

[10] Integrated Regulatory Review Service, IRRS

such as responsibilities, lines of communication, interfaces between various levels in the organisation, the required level of expertise and the requirements in terms of education and training. An elaborated training plan ensures that sufficient numbers of trained personnel with sufficient expertise are always available. Any change to the organisation, for example to the management, must be reported to the authorities. Furthermore COVRA is attracting new staff to guarantee its knowledge level on waste disposal.

2. *Proceeding from storage to disposal including public acceptability*

The national programme describes the route the Netherlands is taking towards disposal. The action points in the national programme help to measure the progress of the process. After the period of long-term storage, geological disposal is foreseen around 2130. The decisionmaking therefore is expected around 2100.

One of the ways acceptability on disposal can be gained is by participation of the public. A study on participation (2015) revealed that as yet, it is not meaningful to intitiate public participation around disposal: the absence of an actual decision on the location means that at present the urgency to participate is also lacking among citizens. In due course national and international developments on management of radioactive waste will change this. Not only residents of the Netherlands but for instance also local governments, social organisations, the waste management organisation and scientists are needed to participate. Any decision on the management of radioactive waste in the long term can only be taken if considered by society, if every stakeholder has got the opportunity to play his or her role, and if all players are confident in one another.

By preparing trend analyses every three years and having the meaning of the trends assessed by a consultation group, progress will be maintained in the process towards disposal. The consultation group will be established in 2018 and will advise the ANVS on several aspects concerning disposal. Participation is one of the aspects the consultation group will be asked to advise on.

In the meantime, the Parliament and the public will be informed about radioactive waste management. For instance, during the consultation moments of licensing procedures regarding waste management, by this report, the updates of the national programme, the national report on implementation of the national programme as obliged by Council Directive 2011/70/Euratom as well as policy papers. All of these are available to the public.

Both COVRA as well as ANVS publish these and other information on their websites (www.covra.nl and www.anvs.nl). The information is constantely kept up-to-date. ANVS has the legal task to inform the public on nuclear safety and radiation protection. COVRA gives a lot of attention to communication, both to stakeholders as well as to the public.

Refer to the section on Article 20.2 for more information on reporting and information to the public.

3. *Transfer of historical radioactive waste from Research Location Petten to COVRA*

The Waste Storage Facility (WSF) in Petten was used as part of a central radioactive waste management facility from the late 1970s until the COVRA facilities in Nieuwdorp were erected in the 1990s. Before that, the WSF was already used as the storage facility for the research location Petten since the early 1960s. During the 1990s, all drums containing low and intermediate level waste were transported to the COVRA facility. The high level mixed waste that could not be transported directly from the WSF without repackaging and treatment remained in Petten.

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 several 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. Between 2014 and 2016, all drums that were known or expected to contain PVC (based on archived information), about 130 in total, were sorted, repacked, and prepared for storage at COVRA. The PVC was removed from the highly active waste and repackaged separately. All other legacy waste will also be sorted, treated, repacked and shipped to COVRA. It is intended that all legacy waste from the WSF in Petten will have been removed before the end of 2022.

4. *Long-term knowledge management on radioactive waste management*

In the Netherlands, a few institutes have several decades of experience with the research into final disposal and the drafting of safety cases. Notable institutes, which have been involved in most of the past and present national research programmes regarding (geological) waste disposal, are the TNO institute's geosciences branche and the Nuclear Research & consultancy Group (NRG).

The national WMO is attracting new staff to be able to maintain its knowledge on final disposal at a sufficient level.

The process towards the realisation of a disposal facility stretches over several generations. In that process, it is essential that knowledge be assured. This is a multifaceted issue. Figure 2 is a diagrammatic representation.

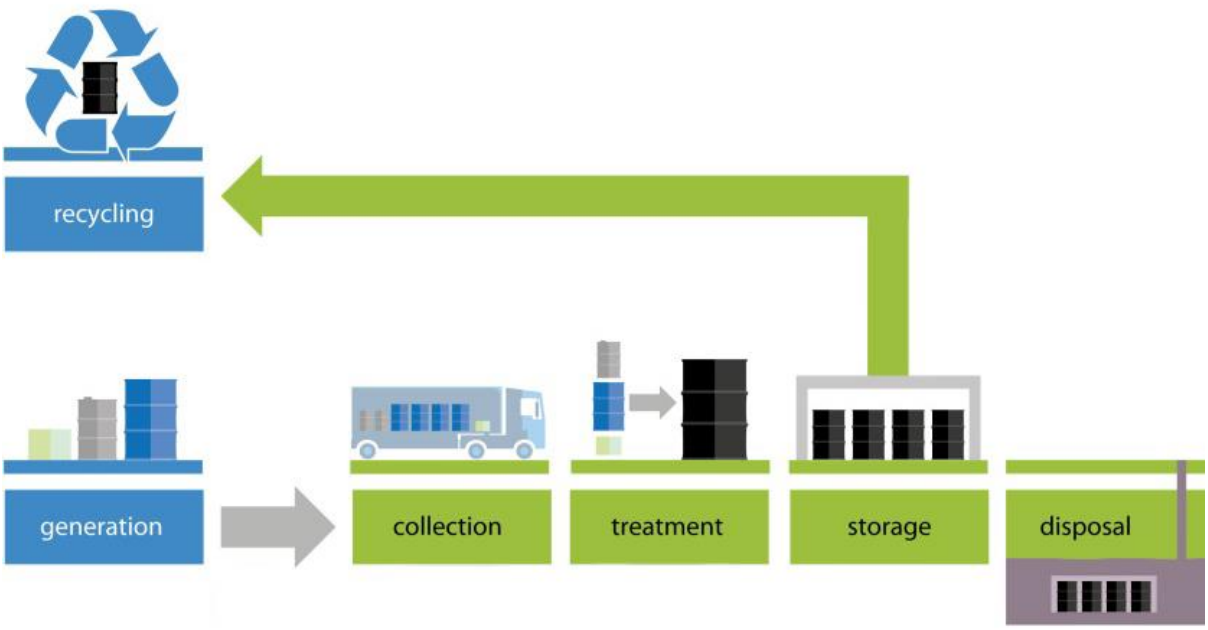

Figure 2 Facets of knowledge assurance for disposal in the management chain for radioactive waste. From production to collection, treatment, storage and disposal.

The following points must be considered:

- *Knowledge of the properties of the waste*
  During the period of aboveground storage, COVRA is responsible for keeping an up to date administration of the waste and assuring the knowledge related to safe storage of the waste stored at the location. This is not only important for the future when the waste is placed in the disposal facility, but is also an important aspect of safe day-to-day operations. On the basis of the properties of the waste (for example precisely which materials are stored in which containers, the chemical structure, the activity of the material and the amount of radiation being emitted by the waste, but also about the conditioning and packaging methods), it is possible in the future to make a sound choice on the future management method for the various types of waste.

- *Technical and socioeconomic knowledge*
  Technical substantive knowledge in respect of radioactive waste management is acquired through research, on both a national and international scale. In addition to international cooperation, research has been underway in the Netherlands for dozens of years into the safe disposal of radioactive waste.
- *(Transfer of) Knowledge*
  Maintenance of knowledge of the properties of the waste and the disposal facility(ies) is necessary to inform future generations of what will be located belowground, and why. In (international) research programmes into disposal, much attention is focused on how this information can continue to be transferred for the very long term. Because the decision has been taken in the Netherlands to store radioactive waste aboveground till 2130, this also allows time to learn from experiences abroad.

Overview matrix of liabilities and current policies and practices

An overview matrix providing the types of liabilities and the general policies and practices for the Netherlands is given hereunder.

Type of liability	**Long-term management (LTM) policy**	**Funding of liabilities**	**Current practices / facilities**	**Planned facilities**
SF	It is up to the licensee to decide if SF is to be reprocessed. RR-SF and HLW resulting from reprocessing of NPP-SF, are to be stored at the facilities of COVRA, the national WMO organisation. Licensees pay all-in tariffs that are determined by COVRA and which cover all expected costs of storage and disposal of radioactive waste (RW). It is envisaged that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological repository.	If applicable, SF producers fund the reprocessing of SF and management of resulting wastes Via RW tariffs, LHs fund storage and disposal of their SF. Upon transferral of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA.	SF of NPP is reprocessed in France; resulting vitrified HLW stored in HABOG at COVRA. SF of RRs in dry storage in HABOG at COVRA.	A geological disposal facility is envisaged around 2130. As a result of Long Term Operation of the NPP till end of 2033 an extension of HABOG at COVRA is ongoing.
Nuclear Fuel Cycle waste	All radioactive wastes from NFC facilities have to be stored at the facilities of COVRA. Licensees pay all-in tariffs that are determined by COVRA and which cover all expected costs of storage and disposal of RW. It is envisaged that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological repository.	Via RW-tariffs, LHs fund storage and disposal of their radioactive wastes. Upon transferral of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA.	All NFC waste is transferred from LH to COVRA followed by storage in aboveground facilities at COVRA.	A geological disposal facility is envisaged around 2130.

Type of liability	**Long-term management (LTM) policy**	**Funding of liabilities**	**Current practices / facilities**	**Planned facilities**
Application wastes	All radioactive wastes have to be stored at the facilities of COVRA. Licensees pay all-in tariffs that are determined by COVRA and which cover all expected costs of storage and disposal of RW. It is envisaged that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological repository.	Via RW tariffs, LHs fund storage and disposal of their radioactive wastes. Upon transferral of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA	All radioactive waste is transferred from LH to COVRA followed by storage in aboveground facilities	A geological disposal facility is envisaged around 2130.
NORM waste	Disposal of NORM waste between 1 – 10 times the clearance levels at designated landfills. For NORM waste with an activity concentration > 10 times the clearance levels: see application wastes.	Via RW tariffs, waste producers fund disposal of their radioactive wastes.	Disposal of NORM waste between 1 – 10 times the clearance levels at designated landfills.	No planned facilities.
Decommissioning Liabilities	Since 2011 it is mandatory for LHs of nuclear facilities to choose the immediate decommissioning strategy in their decommissioning plan. In exceptional circumstances, the Minister can allow different strategies. Bkse requires the LH of a nuclear facility to have and periodically (every five years) update a decommissioning plan during the lifetime of the facility and submit it to the RB for its evaluation and decision on approval. Furthermore, the LHs of nuclear reactors are required to have a	LHs of nuclear reactors are required to have Financial Guarantee (FG) to fund future decommissioning and resulting waste management costs. The Ministers of Finance and of Infrastructure & the Environment are responsible for the evaluation and approval of FGs.	LHs of NFC facilities are required to have an up-to-date decommissioning plan throughout their entire lifecycle. LHs of nuclear reactors are required to have also an updated FG.	Currently a RR (LFR) is under decommissioning. A NPP is in Safe Enclosure (Dodewaard).

Type of liability	Long-term management (LTM) policy	Funding of liabilities	Current practices / facilities	Planned facilities
	secured financial provision (Financial Guarantee, FG) to cover the costs of decommissioning (including a contingency add-on). The FG will have to be updated and approved by the authorities at least every time the decommissioning plan is updated. Ultimate responsibility rests with the LH.			
Disused sealed sources	All import, manufacturing, storage, use, export and disposal of radioactive sources needs a licence. All radioactive wastes have to be stored at the facilities of COVRA. Licensees pay all-in tariffs that are determined by COVRA and which cover all expected costs of storage and disposal of RW. It is envisaged that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological repository.	HASS (High Active Sealed Sources) are regulated according to EU regulations[11], implemented in Dutch regulation for licensing, registration & require financial guarantee.	If reuse is not possible, disused sealed sources are preferably returned to the supplier or manufacturer. All radioactive waste is transferred to COVRA, followed by storage in above-ground facilities at COVRA. Most orphan sources are found during routine radiological monitoring of scrap material with portal monitors at scrap yards.	A geological disposal facility is envisaged around 2130.

[11] 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

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 on the management of radioactive waste also applies to SF and is described in section 32.1 (iii). In this section, only SF-specific aspects of the policy are included.

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

In the case of a new nuclear power plant, the licence holder will have to evaluate the 'back-end' strategy every ten years. Central government does the same every twenty years. Depending on these evaluations, a different strategy may subsequently be imposed on the licence holder. Even in the case of reprocessing, the operator remains responsible for the safe storage of radioactive waste.

32.1 (ii) Spent fuel management practices

Spent fuel from the NPPs

Borssele NPP

The Borssele NPP has a licence that allows the temporary storage of SF in the SF pool at the reactor site to reduce residual heat before shipping to France for reprocessing. 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, the SF is transferred to AREVA's facilities in La Hague (France) for reprocessing after the cooling period. Regular transports should ensure that the fuel pool inventory is kept to a practical minimum, as required by the plant's operating licence.

In July 2006 new French legislation entered into force, which prescribes that a returnscheme for the radioactive waste has to be formalised at the moment the spent fuel is sent to France. In 2009 a bilateral agreement between France and the Netherlands was signed regulating this matter for Dutch spent fuel produced until 2015. A new treaty was signed regulating Dutch spent fuel produced after 2015, its receival by Areva NC[12] in France, its reprocessing and the return of radioactive wastes from reprocessing to the Netherlands before 31 December 2052.

[12] AREVA NC: AREVA Nuclear Cycle, subsidiary of the AREVA Group.

After reprocessing, resulting vitrified waste is sent to the Netherlands for storage at COVRA's HABOG facility.

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 MOX fuel for NPPs.

The Borssele NPP has started using MOX fuel. A licence for this was granted in June 2011, and the first MOX elements were loaded in 2014.

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 an European NPP. The separated plutonium has been sold to AREVA and the British Nuclear Decommissioning Authority (NDA). The resulting vitrified waste was returned from Sellafield to the Netherlands in March 2010, and shipped to COVRA for long-term storage.

Spent fuel from the research reactors

SF from research reactors is stored in 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 in Petten only uses low-enriched uranium (LEU) fuel. 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 in Petten was very low. The original fuel elements were still in use till the permanent shut-down of the reactor in 2010. All SF has been transferred to COVRA in December 2013.

At the HOR in Delft a conversion of HEU fuel to LEU fuel was started in 1998. 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

In the Introduction, the main elements of the Dutch policy on the safe management of spent fuel and the safe management of radioactive waste have been described. Summarized the policy on radioactive waste and SF management is: longterm aboveground storage in dedicated buildings at a centralized storage facility followed bij geological disposal. Geological disposal is envisaged around 2130. This section gives a more detailed description of that policy. The various elements of the policy apply to radioactive waste as well as to SF.

National Programme for the management of radioactive waste and spent fuel satisfying Council Directive 2011/70/Euratom

The current policy on the safe management of SF and radioactive waste has been documented into much detail in the 'national programme for the management of radioactive waste and spent fuel'[13] that was published in 2016 in compliance with Council Directive 2011/70/Euratom. It is the most recent and complete official publication detailing the policy on the management of SF and radioactive waste and it also includes other related issues like an inventory and a description of the route to disposal.

[13] www.anvs.nl

The national programme will be updated at least every ten years. This matches the period laid down in the Directive.

National policy satisfies the requirements of the Directive

The national policy on the management of SF and radioactive waste satisfies the principles set out in article 4.3 of the Directive:

“4.3 National policy shall be based on all of the following principles:

a) the generation of radioactive waste shall be kept to the minimum which is reasonably practicable, both in terms of activity and volume, by means of appropriate design measures and of operating and decommissioning practices, including the recycling and reuse of materials;

b) the interdependencies between all steps in spent fuel and radioactive waste generation and management shall be taken into account;

c) spent fuel and radioactive waste shall be safely managed, including in the long term with passive safety features;

d) implementation of measures shall follow a graded approach;

e) the costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials;

f) an evidence-based and documented decision-making process shall be applied with regard to all stages of the management of spent fuel and radioactive waste.”

New additional policy: decay storage

There are forms of radioactive waste that require several tens of years to decay below the threshold values. According to regulations such wastes shall be stored at COVRA. However the Government has the objective of a circular economy and wishes to stimulate the market for renewable raw materials and the reuse of scarce materials.

Therefore it is possible to store such radioactive materials unprocessed at COVRA for a period of not more than 50 years. After decay below clearance levels, the material can be reused as raw materials.

New additional policy: investigation of conditions for import and export

In parallel to the efforts aimed at international cooperation, the possibility and desirability of imposing conditions on the import and export of radioactive waste substances for storage and/or disposal in the Netherlands will be investigated.

New additional policy: flexibilisation of the timetable and disposal method

Developments may take place in the future, such as innovations or international cooperation in creating a multinational disposal facility, as a result of which society will want to deviate from the selected timetable of aboveground storage at COVRA till 2130. Because radioactive waste is stored aboveground, it is possible in the Netherlands to deal flexibly with the timetable.

For short-lived low-level and intermediate-level radioactive waste, in principle a disposal at the surface is also sufficient. Therefore the possibility will be kept open to be flexible in the choice of the long-term management option. However, until a political change is made in the existing policy line for the timetable and disposal method, the programme aimed at creating one national geological disposal facility for all radioactive waste (including spent fuel) will be continued.

Policy on radioactive waste and spent fuel – links to other policy fields

The policy on radioactive waste is part of the policy on radiation protection, which protects individuals, society and the environment against the risks of exposure to ionising radiation. Exposure to radiation must be justified, as low as reasonably achievable (ALARA) and must remain within specified thresholds. Anyone using ionising radiation bears prime responsibility for its use. The same principles are applied to the management of radioactive waste.

The policy applies a graded approach; the greater the risk, the stricter the regime. For example, the requirements imposed on activities involving SF are stricter than for activities involving other radioactive substances.

The policy on radioactive waste ties in with the policy in respect of conventional waste. As far as possible, for example, the policy strives to close raw materials cycles as far as possible, with priority to be given to the most environmentally friendly possible processing methods. In the policy on radioactive waste, the same preferred order for processing is assumed as for conventional waste: prevention, reuse and finally, safe management of remaining waste substances.

Furthermore, as with management of conventional waste, the IBC-principle[14] is applied to the management of radioactive waste: isolate, manage and control.

Policy on long-term management of radioactive waste and spent fuel – a dual strategy

The current generation has been able to profit from the advantages of the use of nuclear power and other applications of radioactivity, and is therefore required to take the necessary steps to ensure safe and responsible management of radioactive waste now and in the future. The policy assumes that the radioactive waste and spent fuel will be stored in buildings (at COVRA) for a period of at least 100 years. This is the stage of 'long-term above-ground storage'. During this period the deep geological disposal is prepared financially, technically and socially in such a way that it can be implemented after the above-ground storage period. It is foreseen that the disposal facility will be ready to receive radioactive wastes around 2130. The definitive decision on disposal will be made around 2100 at the latest. At that moment, society may also choose another management option, depending on insights, knowledge, and other feasible alternatives at that time.

Some positive effects of having a long-term above-ground storage in buildings are:

- Heat generating waste will cool down during this period and the material will be easier to handle and to dispose of;
- A substantial volume of radioactive waste will decay to below the clearance level and consequently will not need to be disposed of in a deep geological disposal facility or in a permanent surface disposal;
- Meanwhile there is time for research into the best long-term solution and new techniques; other management options may become available;
- During the long-term storage period, international or regional solutions may become available. Cooperation creates financial benefits and may even result in higher safety standards;
- There is a lengthy period available to allow growing of a capital provision to the desired level;
- There is time to learn from the experiences with geological disposal in other countries.
- Future generations will be given the opportunity to choose a long-term management option based on their own understanding, with the least possible burden.

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[14] IBC, Dutch acronym meaning: 'Isoleren, Beheren en Controleren, i.e. isolate, manage and control.

Of course long-term above-ground storage poses some challenges like maintaining knowledge and public participation (see main challenges in Introduction). It also forces to construct safe and robust storage buildings. Disposal should be kept on the agenda in order to take steps forward, Council Directive 2011/70/Eurotom assist with the obligation to report on the progress every three years.

To finally achieve disposal, both a national and an international line are being followed: a 'dual strategy'. Within this strategy, a national route towards disposal will be elaborated. At the same time the possibility of international collaboration will not be excluded. The dual strategy makes it possible to respond appropriately to possible international initiatives regarding management of radioactive waste.

The costs of a national disposal facility will be relatively 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 has representatives in the ERDO (European Repository Development Organisation) working group. The working group exchanges knowledge and addresses the common international challenges in managing radioactive waste. Possibilities are also being investigated of establisching a European waste management organisation.

For an overview of all international cooperations by the Netherlands, refer to Annex 3 'International orientation and collaborations'.

Policy on long-term management: geological disposal with retrievability

At this moment,geological disposal is internationally seen as the only method for safe disposal of radioactive waste. In the Netherlands, geological disposal is envisaged around 2130.

It should be realized that the cumulative waste volume that is actually in storage right now in the Netherlands, is several tens of thousands cubic meters. In volume alsmost all is LILW. It is intended to dispose of all types of radioactive waste in one disposal facility, ranging from LILW to heat-generating HLW. the waste volume anticipated to be collected during the aboveground storage period was judged as large enough to make a disposal facility economically viable in the future.

It is a political decision that the design of the disposal facility must allow the retrieval of the waste (via the existing shaft) during the use of the disposal facility.

Retrievability has the advantages:

- The radioactive waste in the disposal facility is available for reuse if possibilities become available. If those possibilities arise, the waste can be reused in a manner that is environmentally and hygienically responsible. This leaves the freedom to act to future generations;
- In the period in which the disposal facility has not yet been closed, and the waste is still retrievable, it is possible to assess whether the geological disposal facility is functioning as expected. Any necessary changes can then be made relatively easy.

There is a relationship between the ease of retrievability of radioactive waste from the disposal facility versus the costs of retrieval and the aspects of safety in respect of passive versus active monitoring during the term of disposal. Retrievability is a property of (the design of) the geological disposal facility. The degree of retrievability changes over time, in the long-term the behaviour of a retrievable disposal facility is no different than the behaviour of a non-retrievable facility.

The optimum period of retrievability will be assessed in consultation with society.. At the moment the intention is to have retrievability of waste possible at least during the operational phase of the disposal.

Public Participation

Transparency of nuclear activities and close communication to the public aid to enable a dialogue among stakeholders and the public debate on the final disposal, at the same time yielding confidence in the regulator and in the safety of radioactive waste management. Public communication is one of the tasks of the ANVS. There are several regulations that describe the role the general public plays and the participation in various procedures. Details can be found in the texts on Article 19.

As mentioned in the Introduction, the consultation group might advise the ANVS on several aspects concerning disposal, public participation can be one of the aspects.

Supporting research programme

The Netherlands has a history of more than four decades of research into the long-term safe management of spent fuel and radioactive waste (see Annex 4). Results from the research programmes have been used as input to the development of the policy on the safe management of spent fuel and radioactive waste. Various expert organisations in the Netherlands[15] have been involved in all of these programmes - sometimes via their predecessor organisations.

The current national research programme is named OPERA. It started in July 2011. COVRA has been asked to coordinate this 10 million euro research program the costs of which are divided between the nuclear industry and the government. Various organisations have been contracted to perform parts of the research programme. 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 the end of 2017.

32.1 (iv) Radioactive waste management practices

Overview

The following table[16] shows the various categories of radioactive waste and their management methods, now and in the future. They are explained further in the next sections.

Table 1 Categories of radioactive wastes and their management options

<table>
<tr><td>Category radioactive waste</td><td>Interim management</td><td>Long term management</td></tr>
<tr><td>HLW</td><td>Aboveground storage at COVRA</td><td rowspan="3">Geological disposal[17]</td></tr>
<tr><td>LILW</td><td>Aboveground storage at COVRA</td></tr>
<tr><td>NORM, as far as transferred to COVRA</td><td>Aboveground storage at COVRA</td></tr>
<tr><td>NORM subject to notification</td><td>Storage on location</td><td>Designated landfill</td></tr>
<tr><td>Radioactive waste with T1/2 < 100 days</td><td>Storage on location for a maximum of 2 years</td><td rowspan="3">Reuse or reprocessing as conventional waste</td></tr>
<tr><td>Radioactive waste decaying below clearance levels in 50 years</td><td>Aboveground storage at COVRA</td></tr>
<tr><td>Radioactive waste below clearance levels</td><td>-</td></tr>
</table>

[15] TNO and its geological branche and NRG in Petten.

[16] Adapted from table on page 25 of the national programme.

[17] Radioactive waste that has decayed till below exemption levels at the time of disposal will be treated as conventional waste.

Storage facilities

One national central storage facility: COVRA

Most of radioactive waste produced in the Netherlands is managed by COVRA in Nieuwdorp, which has centralized, dedicated facilities for the above-ground storage of all types of radioactive waste. There are some exceptions:

- Radioactive wastes with a half-life less than 100 days, are allowed to decay for a maximum period of two years at the sites where they are being generated.
- Large amounts of NORM waste is reused or disposed of at (designated) landfills,
- Some legacy waste is still present at the research location Petten (see below in section on the waste storage facility).

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's storage facilities and property have been designed to last at least one hundred years. However if needed they can be refurbished or replaced to accommodate a longer above-ground storage period.

Further details on the facilities of COVRA can be found in Annex 1 'Interim Waste Storage Facilities'.

Waste Storage Facility (WSF) in Petten

There still is an amount of legacy waste present in the WSF building at the Research Location Petten. This waste, resulting from four decades of nuclear research at that location, consists of fuel material residues (spent uranium targets and irradiated fuel) and fission and activation products. During the 1990s, all drums containing low and intermediate level waste were transported to the COVRA facility. The high level mixed waste that could not be transported directly without repackaging and treatment remained in Petten. Between 2014 and 2016 some 130 drums known or expected to contain PVC (causing corrosion) were sorted, repacked and prepared for shipment to COVRA. The PVC was removed and repackaged separately. It is intended that all legacy waste from the WSF at Petten will have been removed before the end of 2022. For more detailed information refer to the text with Article 12(ii) 'Past Practices' in this report.

Geological disposal facilities

At the moment there are no geological disposal facilities in the Netherlands. Neither are there Underground Research Laboratories (URLs). For research purposes, foreign URLs are used.

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 Figure 3 and Figure 4).

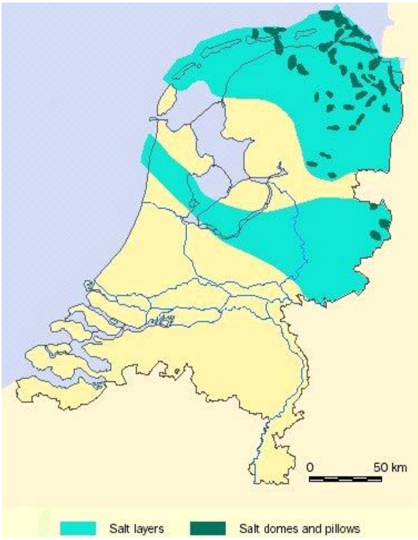


Figure 3 Distribution of salt formations

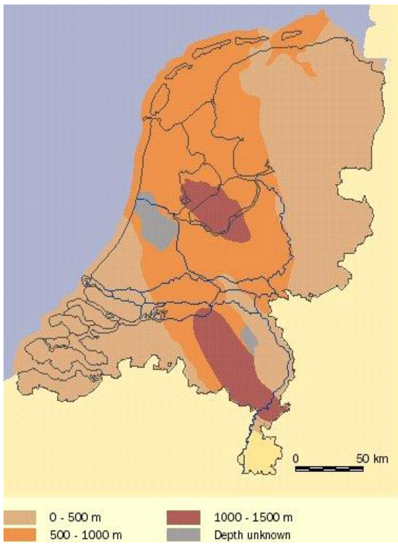


Figure 4 Distribution and depth of the Boom Clay

The various types of radioactive wastes, their origin and their management

LILW - 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 LILW-waste in cement, originating from nuclear power plants, are delivered in a conditioned form to COVRA. The radioactivity is dominated by the radionuclides Co-60, H-3 and Cs-137.

COVRA has dedicated storage buildings for the storage of LILW. For details refer to Annex 1.

A substantial volume of LILW waste will decay to a non-radioactive level during the storage period. To keep track of the actual level of radioactivity, 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. As part of the implementation of Council Directive 96/29/Euratom research is currently ongoing on this topic.

NORM

Naturally Occuring Radioactive Materials (NORM) occur as by-products from ores – and other raw materials. NORM is generated in processing industries or as industrial wastes and are enriched with radioactive elements found in the environment. NORM will be considered as radioactive waste, if no further commercial use is foreseen.

Sometimes NORM has natural radioactivity concentrations in excess of the exemption levels. These levels have been specified in an ordinance on radiation protection.

Below the exemption levels, no notification to the authorities is needed for handling of NORM. As far as possible this material is reused, for instance as additives for the preparation of building materials or for road construction.

Above the exemption level but below ten times this level, a notification to the competent authority is sufficient for handling NORM. The legislation for NORM allows the industry generating it, to mix it up with other materials for recycling purposes as long as this activity does not result in an increased risk to individuals, society and environment. Mixing up NORM with the solitary aim of dilution is not allowed. NORM also exist as bulk materials for which future use is foreseen at storage facilities of the raw materials processing industries. Examples are uranium or thorium bearing ores or zirconium oxides.

In case no commercial use is foreseen and NORM is declared as waste, and the activity concentration levels are less than ten times the clearance levels, it can be disposed of at designated landfills.

In case no commercial use is foreseen and the clearance levels are exceeded by a factor of 10 the NORM shall be transferred to COVRA. Examples are 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 clearance levels within 100 to 150 years. So, after such a foreseen storage period 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.

Depleted uranium as a special case of NORM

Depleted uranium originating from the uranium enrichment facility of URENCO is also categorized as NORM. 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 COVRA. 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. In 2017 a second depleted uranium storage building (VOG-2) became operational. VOG-2 has three storage modules, with each module having a capacity of 2,193 containers.

HLW - High-level Waste

The HLW at COVRA consists of:

- heat-generating waste like vitrified waste from reprocessed spent fuel from the NPPs in Borssele and Dodewaard, spent fuel from the research reactors and spent uranium targets from molybdenum production and
- 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 period, 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 of the waste packages and HABOG is 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.

Preparations are underway to expand the storage capacity of HABOG with two additional vaults for the storage of heat-producing high-level waste. Design started in 2016, construction started in 2017.

The SF elements of the research reactors are delivered to COVRA in a cask containing a basket with about 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.

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

The definition of radioactive waste is given in the Radiation Protection Decree, the Bs[18]: "a radioactive substance can be designated as radioactive waste by the Mininster of Infrastructure and the Environment, or the commercial operator, if no product or material reuse is planned for the material either by the Mininster or by the commercial operator, and there is no question of dumping the material".

As stated before, most (in terms of activity) of the radioactive waste is collected and managed by COVRA. Long-term above-ground storage of all radioactive waste in buildings preceeding final disposal, has been chosen as the preferred national policy. Consequently, classification of the waste is based on practical criteria both derived from the need to limit exposures during the prolonged above-ground storage period and from requirements set by the final disposal route.

In the Netherlands, radioactive waste is divided into four categories: high-level radioactive waste (HLW, non-heat generating and heat generating), low-level and intermediate-level radioactive waste LILW (including NORM waste), short-lived waste and exempt waste. These categories are based on activity and half-life. Roughly speaking, the IAEA categories high-level waste and intermediate-level waste equate broadly with the Dutch category HLW and the IAEA categories low-level waste and very low-level waste with the Dutch category LILW.It is envisaged that all categories of radioactive waste (including SF) will be disposed of in one deep geologic repository in the future. Due to the small amounts of radioactive waste, no separate disposal facilities for LILW and HLW are foreseen.

The waste in the storage buildings for LILW is segregated according to the scheme in Table 2.

Table 2 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 radioisotopes with a half-life longer than 15 years
D	Beta/gamma contaminated waste from producers other than nuclear power plants with radioisotopes 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.

[18] Dutch: Besluit stralingsbescherming, Bs

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 NPP which has been transferred to France 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) for which no further commercial use is foreseen, in quantities or concentrations exceeding the clearance levels 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 3, a list of the spent fuel management facilities subject to this Convention, their location and essential features is given.

Table 3 Spent Fuel management facilities

Location	Spent fuel storage facility	Features
Nieuwdorp COVRA	Dry storage in vaults at COVRA	COVRA facility for treatment and storage of HLW and SF (HABOG)
Borssele NPP	Fuel storage pool at NPP	Pool belongs to NPP where SF is stored temporarily before shipment to France for reprocessing
Petten RR	Fuel storage pool of RR HFR	Pool belongs to RR where SF is stored temporarily before shipment to COVRA
	Dry storage in vaults at WSF	Legacy SF samples from HFR irradiation experiments; stored in drums in concrete-lined vaults. To be transferred to COVRA[19].
Delft	Fuel storage pool of RR HOR	Pool belongs to RR where SF is stored temporarily awaiting shipment to COVRA

32.2 (ii) Inventory of spent fuel

The inventory of spent fuel at 31st December 2016, stored at the COVRA facilities, is summarized below:

SF of NPPs[20]	0 m^3	0 Bq
SF of RRs	6.2 m^3	72.4 PBq
Uranium targets	1.2 m^3	2.7 PBq

32.2 (iii) Radioactive waste management facilities

In Table 4 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 for a maximum of two years. NRG is not allowed to store new waste in the WSF.

[19] More details can be found in section 12(ii).

[20] All NPP SF is reprocessed.

Table 4 Radioactive waste management facilities

Location	Radioactive waste storage facility	Features
Nieuwdorp COVRA	Dry storage of HLW in cannisters	COVRA facility for treatment and storage of HLW and SF (HABOG)
	Dry storage of LILW in conditioned form in drums and containers	COVRA facilities for treatment and storage of LILW (AVG and LOG)
	Dry storage of NORM waste in containers	COVRA container storage facility (COG) for material in unconditioned form
	Dry storage of depleted uranium oxide in small containers	COVRA facility for storage of depleted uraranium oxide as U_3O_8 in unconditioned form to allow for potential future reuse (VOG and VOG-2)
Petten WSF	Dry storage of unconditioned waste in drums.	Partly HLW from irradiation experiments. To be transferred to COVRA[21].
Nauerna & Rotterdam	Disposal of NORM waste between 1 – 10 times clearance levels	Designated landfills

32.2 (iv) Inventory of radioactive waste at COVRA

The inventory of radioactive waste at 31st December 2016, stored at the COVRA facilities, is summarized below:

HLW (excluding SF)	91 m^3	2,625 PBq
LILW	11,109 m^3	2,510 TBq
NORM-wastes	20,622 m^3	592 TBq

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

In Table 5 a list of nuclear facilities in the process of being decommissioned is given.

Table 5 Nuclear facilities being decommissioned

Facility	Date of final shut down	State of decommissioning
Dodewaard NPP	1997	Safe enclosure as of 01/07/2005, decommissioning planned for 2045
LFR	2010	Decommissioning ongoing, fuel removed and transported to COVRA.

[21] More details can be found in section 12(ii).

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;

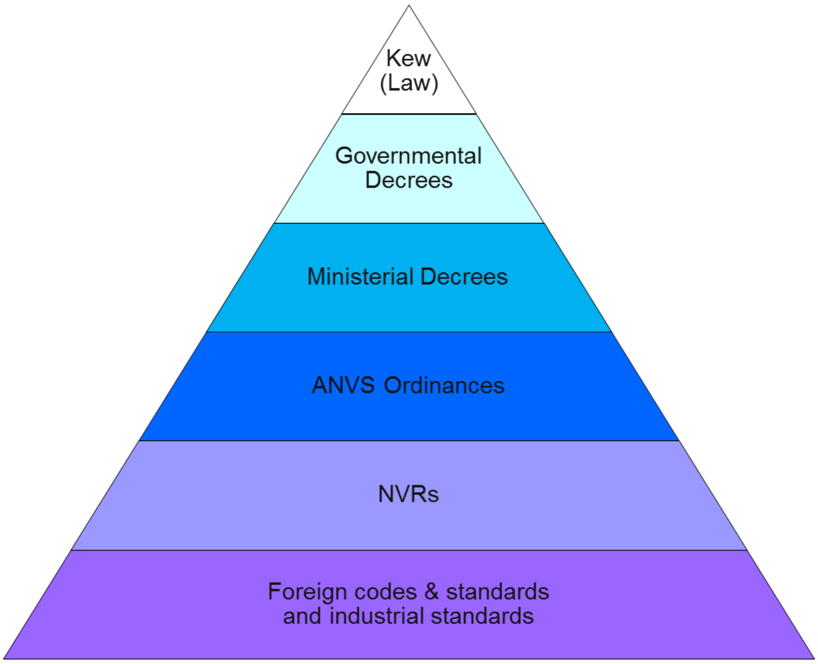
(vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

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 5.



The Nuclear Energy Act (Kew) is the most prominent law.

Governmental Decrees contain additional regulation.

Ministerial Decrees contain additional regulation.

ANVS Ordinances give additional guidance or rules for certain topics.

NVRs are safety requirements referenced in the licence of the NPP.

Various codes and standards are part of the licensing base.

Figure 5 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[22]) 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. For the management of spent fuel and radioactive waste, in particular the following governmental decrees are relevant:

- The Radiation Protection Decree (Bs[23]);
- The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse[24]);
- The Transport of Fissionable Materials, Ores and Radioactive Substances Decree (Bvser[25])
- the Radioactive Scrap Detection Decree[26].

[22] Dutch: KEW, 'Kernenergiewet', Nuclear Energy Law

[23] Dutch: Bs, 'Besluit Stralingsbescherming', Radiation Protection Decree, it should be noted that a major update is being finalized.

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

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

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

At a lower level there are the ministerial decrees[27]. These can be issued by the minister responsible for conducting the regulatory process under the Nuclear Energy Act.

Since August 1st 2017 the ANVS has been established as an independent administrative authority, which is authorized to issue not only NVRs based on IAEA Safety Standards, but also 'ANVS Ordinances'. ANVS ordinances will be issued if:

- guidance or rules are needed on technical or organisational issues;
- guidance or rules relevant to nuclear safety, radiation protection and security are needed; and
- Governmental Decrees or Ministerial Decrees refer to guidance to be provided in an ANVS Ordinance.

In the hierarchy of the legal framework the ANVS Ordinances are positioned between the Ministerial Decrees and the NVRs.

The Nuclear Safety Rules (Dutch: NVRs[28]) are based on IAEA Safety Standards. The Nuclear Energy Act (Article 21 section 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 current NVRs, which are contained in the licence of NPP Borssele, the WENRA Reactor Safety Reference Levels published in 2008 have been implemented. Implementation of the WENRA SRLs published in 2014 is ongoing.

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 (of which one is in decommissioning), 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. Legal framework within which the RB functions

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, transport safety, security and safeguards. In 2015 the various entities that formerly constituted the RB, have largely merged into one entity, the newly established Authority for Nuclear Safety and Radiation Protection, ANVS[29]. The ANVS brings together expertise in the fields of nuclear safety and radiation protection, as well as security and safeguards.

Since the publication of the 5th national report to the Joint Convention in 2014, some changes were included in the Nuclear Energy Act. A prominent change established that the Minister of Infrastructure and the Environment became the principal responsible authority for conducting the regulatory process under the Nuclear Energy Act and for the main functions of the Regulatory Body - the responsible Minister used to be the Minister of Economic Affairs. This change took effect by a Royal Decree of May 1st 2015. Another important step 1st of August 2017 was the update of the Act and subordinate regulation which legally established the ANVS as an independent administrative authority (Dutch acronym: ZBO[30]). The ANVS as a ZBO is independent in its functioning and organising its activities, but the Minister remains politically responsible for its functioning and is accountable to the Parliament.

The tasks of the ANVS can be summarised as follows:

[27] Dutch: MR, 'Ministeriële Regelingen'

[28] Dutch: NVR, 'Nucleaire Veiligheids Regels'

[29] Dutch: ANVS, 'Autoriteit Nucleaire Veiligheid en Stralingsbescherming'

[30] ZBO, 'Zelfstandig Bestuurs Orgaan' or independent administrative authority

- preparing legislation and regulations and policy (including the national programme);
- awarding licences and the accompanying review & assessment and evaluation tasks;
- supervision and enforcement;
- informing interested parties and the public;
- participating in activities of international organisations;
- maintaining relationships with comparable foreign authorities and national and international organisations;
- supporting national organisations with the provision of knowledge;
- having research in support of the implementation of its tasks.

For more information on the organisation and functioning of the RB, refer to the text on Article 20.

19.1.c. Primary legislative framework: acts

19.1.c.1 Nuclear Energy Act (Kew[31])

With regard to nuclear energy, the purpose of the Nuclear Energy Act according to its Article 15b is to serve the following interests:

- 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[32];
- the payment of compensation for any damage or injury caused to third parties;
- the observance of international obligations.

Three areas of application

As far as nuclear installations are concerned, the Nuclear Energy Act covers three distinct areas relating to the handling of fissionable materials and ores (1) registration, (2) transport and management of such materials, and (3) the operation of facilities and sites at which these materials are stored, used or processed:

(1) 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.

(2) 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 Article 15, sub (a) of the Act. The licensing requirements apply to each specific activity mentioned here.

(3) Licences are also required for construction, commissioning, operating, modifying or decommissioning nuclear installations (Article 15, sub b), as well as for nuclear driven ships (Article 15 sub c). To date, the latter category has never been of any practical significance in the Netherlands.

19.1.c.2 General Administrative Act (Awb[33])

The General Administrative 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). It also details the general procedures for the oversight and the enforcement,

[31] Dutch: 'Kernenergiewet', Kew
[32] A modification of the law is being prepared by which 'supply of nergy' no longer will be on the list of interests.
[33] Dutch: 'Algemene wet bestuursrecht', Awb

and - related to the latter - the possible sanctions. This act applies to virtually all procedures under any act, including the Nuclear Energy Act.

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 to enable them to express their opinions. All opinions submitted are taken into account in the final version. Stakeholders that have submitted an opinion to the draft decision are 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.

19.1.c.3 Environmental Protection Act (Wm[34])

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 over the Wm 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 Environmental Impact Assessment (EIA) report. In certain circumstances, an EIA is also required if an existing plant is modified. A permanent committee, 'Commissie m.e.r.', can be consulted for advice to the RB on the desirability of an EIA procedure and on the requirements to be imposed on the EIA-report to be prepared by the licence applicant.

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.d Secondary regulary framework: Governmental Decrees, subordinate to the Nuclear Energy Act

As decribed in section 19.1.a, a number of decrees subordinate to the Nuclear Energy Act have been issued. These contain additional regulations and are continuously updated in the light of ongoing developments. The most important of these degrees in relation to the safety aspects of nuclear installations and radioactive materials are described in somewhat more detail below, including: the Radiation Protection Decree (Bs), the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) and the Transport of Fissionable Materials, Ores, and Radioactive Substances Decree (Bvser).

The Nuclear Energy Act and the above mentioned decrees are fully in compliance with European Council Directives like:

- Council 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;
- Council Directive 2009/71/Euratom, establishing a Community framework for the nuclear safety of nuclear installations, and
- Council Directive 2011/70/Euratom, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste.

19.1.d.1 Radiation Protection Decree (Bs)

The Radiation Protection Decree (Bs) regulates the protection of the public (including patients) and workers against the hazards of all ionising radiation. It also establishes a licensing system for the use of radioactive materials and radiation-emitting devices, and prescribes general rules for their application. For NORM there is a reporting system and

[34] Dutch: Wm, 'Wet milieubeheer'

protective measures for workers and environment. For high active sources, the Bs 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.

As explained in the Introduction, the Netherlands is currently transposing Directive 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom. This is a major task, as it is used as an opportunity for a major rewrite and restructuring of the current Radiation protection Governmental Decree. There will also be some impact on other Decrees. It is planned to finish the transposition on 6 February 2018.

19.1.d.2 Nuclear Installations, Fissionable Materials and Ores Decree (Bkse)

The Bkse and licensing construction, commissioning & operation

The Nuclear Installations, Fissionable Materials and Ores Decree, regulates activities (including licensing) that involve fissionable materials and nuclear installations. The Bkse sets out additional regulations in relation to a number of areas, including the licence application for the construction, commissioning and operation of a nuclear reactor, and associated requirements. 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 installation, including the equipment to be used in it, the mode of operation of the installation 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 installation’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 installation, specifying the maximum quantities of the various fissionable materials that will be present in the installation at any one time;
- a description of the way in which the applicant intends to dispose of the relevant fissionable materials after their use;
- 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 installation 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 Bkse and decommissioning

Bkse includes legislation on decommissioning of nuclear installations and financial provisions for the costs of decommissioning. An important part of this legislation was based on the WENRA Safety Reference Levels on decommissioning.

Bkse requires the LH of nuclear installations to have and periodically (every five years) update a decommissioning plan during the lifetime of the facility and submit it to the authorities for its evaluation and decision on approval. Bkse specifies the minimum requirements on the content of the decommissioning plan. The decommissioning plan (1) serves as the safety-basis for all the activities carried during the decommissioning phase, and (2) it provides the basis for the calculation of the necessary financial provisions for the decommissioning costs.

At present only LHs of nuclear reactors are required to provide a financial security plan for the costs of decommissioning, to update and submit it to the authorities at least every five years for approval. The LH is in principle free to choose the form of the financial provision. Upon approval, the authorities will assess whether the financial plan offers sufficient security for covering the decommissioning costs at the moment of decommissioning.

Modification of the regulation, aiming at extention of this financial requirement to LH of other nuclear facilities is presently being investigated.

19.1.d.3 Transport of Fissionable Materials, Ores and Radioactive Substances Decree (Bvser)

The Transport of Fissionable Materials, Ores and Radioactive Substances Decree, deals with the import, export and inland transport of fissionable materials, ores and radioactive substances by means of a reporting and licensing system.

19.1.e Regulations and guides issued by the Regulatory Body: ANVS Ordinances and NVRs

As explained in section 19.1.a the ANVS can issue ANVS Ordinances that provide guidance or rules on various topics.

At a lower level there are Nuclear Safety Rules, the NVRs[35]. 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, including the NVRs. These regulations are based on the Safety Standards and Guides issued by the IAEA and apply to an installation or nuclear facility as far as they are referenced in their licences. This allows the RB to enforce the requirements of the NVRs.

At the same level as the NVRs exists the 'Guidelines on the Safe Design and Operation of Nuclear Reactors' - Safety Guidelines or VOBK for short. These Safety Guidelines provide new reactor licence applicants with detailed insight into what the ANVS considers to be the best available technology.

19.1.f WENRA Safety Reference Levels

The Western European Nuclear Regulators Association (WENRA) has introduced WENRA Safety Reference Levels (SRLs), aiming to harmonise reference levels for nuclear safety, the safe management of spent fuel and radioactive waste and for decommissioning. In the framework of the Joint Convention especially the WENRA reference levels for storage of radioactive waste and spent fuel and for decommissioning are relevant; they have impact on how waste management and decommissioning is addressed in the Dutch regulatory framework. An example is the regulation on decommissioning and financial provisions for the costs of decommissioning in the Governmental Decree Bkse, an important part of which was based on the WENRA SRLs.

The Netherlands participates in the WENRA Reactor Harmonisation Working Group and the WENRA Working Group on Waste and Decommissioning.

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

This section details the requirements in the regulatory framework with respect to radiation safety as far as it is relevant for the handling of SF and / or radioactive waste.

[35] Dutch: 'Nucleaire Veiligheidsregels', NVRs

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 is 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:

- by transfer to a recognised waste management organisation. COVRA is the only recognized organisation for the collection, treatment and storage of radioactive waste[36];
- by transfer to another designated organisation for the collection of radioactive waste.

LHs 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. Radiation safety requirements

The radiation safety aspects during operations in the spent fuel and radioactive waste management facilities of COVRA are (among others) governed by two Governmental Decrees:

- 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.

b.1 Standard operation

The main elements of the Bs are: (1) justification of the activity, (2) optimization - ALARA and (3) dose limits.

Practices involving ionizing radiation should be justified. The applicant for a licence shall provide the necessary justification. In order to support the justification process, the Dutch regulation features a list of 'justified' and 'not justified practices'.

[36] 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.

The exposure to ionising radiation should be kept As Low As Reasonably Achievable (ALARA). The ALARA-principle is recorded in the Nuclear Energy Act (Article 31), the Bs Decree and in the Bkse Decree.

The dose limit is a maximum total individual dose of 1 mSv for members of the public and 20 mSv for workers in any given year as a consequence of normal operation from all anthropogenic sources emitting ionising radiation (i.e. NPPs, waste management facilities, isotope laboratories, sealed sources, X-ray machines, industries, etc.), thus excluding natural background and medical exposures.

For a single source (for instance a waste management facility), the maximum individual dose for members of the public 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 for individual monitoring and supervision purposes. Category A workers are likely to receive doses greater than three-tenths of the dose limit for workers (6 mSv per year for whole body exposure). The employer shall ensure these workers are subject to medical surveillance and an individual monitoring programme arranged in accordance with requirements of the Bs. Category B workers are likely to be exposed during their work to radiation greater than the dose limit for members of the public (1 mSv per year for whole body exposure), but less than 6 mSv per year. The employer of a category B worker shall ensure that these workers are covered in an individual monitoring programme.

b.2 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 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.

b.3 Safety assessments

The licence application for a waste storage facility shall include a safety assessement. The assessment shall demonstrate that criteria for individual risk and societal risk (mentioned above) are met. The licence usually includes a requirement to periodically update the assessment.

Furthermore, the assessment shall include the evaluation of a set of Design Base Accidents (DBAs), for which protection is included in the design of the facility.

The Bkse Decree specifies that the risks due to DBAs, should be lower than the values given in Table 6.

Table 6 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.

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

Regulatory body conducting regulatory process and scope of Nuclear Energy Act

As described in section 19.1.b, the RB is the authority designated by the government as having legal authority for conducting the regulatory processes based on the Nuclear Energy Act. In 2015 the various entities that formerly constituted the RB, have largely merged into one entity, the newly established Authority for Nuclear Safety and Radiation Protection (ANVS).

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.

Licensing Procedures

General

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 also 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.

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.

Construction licences / operating licences

The Nuclear Energy Act distinguishes between construction licences and operating licences. In theory, a licence to build an installation may be issued separately from any licence to actually operate it. However, the licensing of construction of a nuclear power plant or other nuclear installation involves much more than the construction work. Account must be taken of all activities to be conducted in the installation, during and after its construction. This means that the authorities needs to decide whether the location, design and construction of the installation are suitable, offering sufficient protection of the public and the environment from any danger, damage or nuisance associated with the activities that are to be conducted in the installation.

In practice, the procedure for issuing a licence to operate an installation will be of limited scope, unless major differences have arisen between the beginning, the completion of construction work and the commissioning. 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.

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 very minor modifications, the LH may use a special provision in the Act (Article 17 section 4) that allows such modifications to be made with a minor licence change. This instrument can only be used if the consequences of the modification for individuals, society and the environment are within the limits of the licence in force. The notification is published and is open to appeal.

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.

Decommissioning

For the decommissioning of nuclear facilities a licence is required in a similar way. The requirements to the application are specified in the Bkse Decree and associated subordinate regulation.

Technical advances urging chance of licence conditions

A special possibility for the RB provided for by Article 18a of the Nuclear Energy Act, 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.

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

Under certain circumstances together with a licence application, it is compulsory to conduct an Environmental Impact Assessment or EIA (Dutch: milieu-effectrapportage, m.e.r.). It is for instance compulsory for all new 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.') that advises the RB on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear facilities.

The EIA-procedure (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 licence 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 (SAR) 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, on 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.

Further requirements where necessary - 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. Because of the diversity present, detailed requirements are listed in the licence requirements which are 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. If necessary a tailor-made approach can be employed.

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

Article 15, sub 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

Article 58 of the Nuclear Energy Act gives the basis for entrusting designated officials with the task of performing assessment, inspection and enforcement. The Decree on Supervision[37] identifies the bodies that have responsibilities in this regard. More about the organisation of the RB can be found in the text on Article 20.

Inspections are planned and results of inspections are reported on by the RB. 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;

[37] Dutch: 'Besluit aanwijzing en taakvervulling toezichthouders Kernenergiewet'

- to check that the LH is conducting its activities in accordance with the best technical means and/or accepted industry standards.

Inspection activities are supplemented by international safety review missions. An important piece of information for inspection is the safety evaluation report, which is to be periodically updated. In this report the LH presents its self-assessment of all the relevant technical, organisational, personnel and administrative matters.

The management of inspection is supported by a yearly planning, the reporting of the inspections and the follow-up actions. Dependent on the type of facility and with a certain periodicity, meetings between facility management and RB are held. These meetings are devoted to inspections and inspection findings during which any necessary remedial actions are established and the progress made with their execution is discussed.

The ministerial decree on nuclear safety of nuclear installations[38] requires continuous improvement of (nuclear) safety and the execution of periodic safety reviews. In line with this, the LH of the spent fuel and radioactive waste management facility (COVRA) carries out periodic safety reviews as required by the licence:

- Every 5 years an assessment of the activities and accomplishments in the area of safety, waste management and radiation protection is performed against the licence requirements to conclude about eventual shortcomings and possibilities to improve;
- Every 10 years an comprehensive assessment is performed, where the design, operation, procedures and organisation is compared with current/modern (inter)national standards in order to find reasonably achievable improvements.

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

If the ANVS judges there are serious shortcoming in the actual operation of a nuclear installation, the ANVS is empowered under Article 37b of the Nuclear Energy Act to take all measures as deemed necessary.

Article 19 sub 1 of the Nuclear Energy Act empowers the ANVS to modify, add or revoke restrictions and conditions in the licence in order to protect the interests as laid down in Article 15b of the Act. Article 20a of the Act stipulates that the ANVS is empowered to withdraw the licence, if this is required in order to protect those interests. Articles 22.3, 33.3, 66 and 83a (the latter with a reference to the Wabo) offer the possibility of using administrative enforcement.

Articles 5:21 through to 5:31c of the General Administrative Law Act (Awb) provide a further description of 'Order subject to administrative enforcement'. Article 5:32 grants the authority the power to impose an administrative enforcement order subject to a penalty.

Article 18a of the Nuclear Energy Act empowers the ANVS to compel the LH to cooperate in a process of total revision and updating of the licence. This will be necessary if, for instance, the licence has become outdated in the light of numerous technical advances or if new possibilities to even better protect the population have become available since the licence was issued.

The ANVS has published its 'Oversight and Intervention Strategy' on its website in 2017, to inform all LHs. It among others describes the means of intervention available, a set of admininstrative proceedings and criminal proceedings. Examples of administrative proceedings described in the document are: formally addressing LH, to place under intense supervision, impose an order subject to a penalty for noncompliance, administrative enforcement order and revoking of the licence. As part of the criminal proceedings, staff of the ANVS can impose a fine on a LH or prepare an official report for the public prosecutor, should the need occur.

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[38] Dutch: 'Regeling Nucleaire veiligheid kerninstallaties'

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 RB is described in detail in the text under Article 20. The RB develops policy and prepares regulation in respect of the safe management of spent fuel (SF) and radioactive waste, issues licences and ensures compliance with applicable conditions from regulations and licences.

The LHs hold prime responsibility for the safe management of SF and radioactive waste generated by them, as explained under Article 32.1 'Policies and Practices'. However as soon these materials are transferred to COVRA, responsibility for safe management lies with this organisation.

Almost all[39] of the waste management activities have been centralised in one waste management organisation, COVRA. COVRA collects and manages the funds for the long-term above-ground storage and final disposal.

There is a single organisation (COVRA) that after accepting the radioactive waste is responsible for all further stages of radioactive waste management. This ensures there is clarity on the responsibility for those stages. The central collection, processing and storage of radioactive waste also ensures implementation of key aspects such as environmental hygiene, cost effectiveness and industrial hygiene.

19.3 Regulation of radioactive materials as radioactive waste

A definition of radioactive waste is given in the Radiation Protection Decree, the Bs[40], and has been provided in the text on Article 32.1 (v).

The policy on the management of SF and radioactive waste has been described into detail under Article 32.1 'Policies and Practices'.

By adhering to these policies, and thus minimising the amount of waste while ensuring that the waste 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.

[39] Some NORM is managed on landfill sites.

[40] Dutch: Besluit stralingsbescherming, Bs

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.

General

There is one large entity, the Authority for Nuclear Safety and Radiation Protection (ANVS) and some smaller entities at other ministries that together constitute the RB. However the tasks related to radioactive waste management which is the subject of this report are largely within the scope of the ANVS only. Therefore this report often will refer to the ANVS as the RB. The RB is the authority designated by the government as having legal authority for conducting the regulatory process, including issuing authorizations, inspection and enforcement and thereby regulating nuclear, radiation, radioactive waste and transport safety, nuclear security and safeguards.

All nuclear facilities in the Netherlands, including COVRA, operate under licence, awarded after a safety assessment has been carried out successfully. Licences are granted by the ANVS under the Nuclear Energy Act.

Legal status

The ANVS is an independent administrative authority, a so-called ZBO with its own legal authorities. The ANVS is independent in its regulation of nuclear safety and security in the Netherlands, but the Minister of Infrastructure and the Environment (I&M) bears ministerial responsibility for the ANVS and its functioning. The legal basis for the functions of the competent regulatory authority appear in the Nuclear Energy Act, Govenmental Decrees, Ministerial Decrees and regulations of the RB (ANVS Ordinances).

The ANVS brings together expertise in the fields of nuclear safety and radiation protection, emergency preparedness as well as security and safeguards. For each of these subjects, the ANVS is focused on preparing policy and legislation and regulations, the awarding of licences, supervision and enforcement and (public) information. The ANVS contributes to safety studies and ensures that the Netherlands are well prepared for possible radiation incidents.

Entities of the RB

Several ministers also have responsibilities in specific areas related to the use of radioactivity and radiation under the Nuclear Energy Act, therefore there are still various organisations that together constitute the RB. However, since beginning of 2015, most of the RB staff is employed at the abovementioned ANVS.

Below the status and tasks of the entities of the RB are summarized:

- The ANVS has a staff of approximately 130 fte, to be increased to 141 (including two members of the board). Its legal authorities include licensing and independent supervision (safety assessment, inspection and enforcement) of compliance by the LH(s) and other actors with the requirements on the safety, security and non-proliferation. For some technical and organisational issues it has the authority to formulate and issue regulation (like NVRs and ANVS Guidelines).
  The ANVS supports the Minister of I&M in the preparation of legislation, formulating policies and regulatory requirements on nuclear safety, radiation protection, emergency preparedness, security and safeguards. Furthermore it has responsibilities regarding public communication, international cooperation and knowledge management regarding the areas of expertise mentioned above.
- The ministry of Social Affairs & Employment (SZW[41]) has tasks in the area of protection of the safety of workers against exposure to radiation.
- The ministry of Health, Welfare and Sports (VWS[42]) has tasks in the area of protection of patients against exposure to radiation.

[41] Dutch: 'ministerie van Sociale Zaken en Werkgelegenheid' (SZW), i.e. ministry of social affairs and employment.
[42] Dutch: 'ministerie van Volksgezondheid, Welzijn en Sport' (VWS), i.e. ministry of health, welfare and sport.

- The State Supervision of Mines (SdoM, part of ministry of Economic Affairs) oversees the safe and environmentally sound exploration and exploitation of natural resources like natural gas and oil.
- The Netherlands Food and Consumer Product Safety Authority (NVWA[43]) monitors food and consumer products to safeguard public health and animal health and welfare. The NVWA controls the whole production chain, from raw materials and processing aids to end products and consumption. The NVWA is an independent agency in the Ministry of Economic Affairs and a delivery agency for the Ministry of Health, Welfare and Sport.
- The Inspectorate of the ministry of I&M (ILT[44]) has general supervision responsibilities for the compliance with the requirements of modal transport regulations.
- Minister of Defence has its inspectorate military healthcare (IMG[45]) for overseeing a healthy and safe work environment for the civilian and military staff of the ministry of defence. Its scope includes applications of ionizing radiation and accounting for the use of radioactive sources within the military.

Apart from the ANVS, most entities of the RB employ only a limited number of staff for the Kew-related tasks.

In addition to day-to-day contacts between the entities of the RB, there is a collaboration agreement[46] on radiation protection between the ANVS and the policy departments and inspectorates of other ministries with responsibilities under the Nuclear Energy Act that are part of the RB.

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 which specifies this requirement. Furthermore in June 2017 an update on this directive, the Directive 2014/87/Euratom, was implemented in Dutch regulation with the publication of a new Ministerial Decree on the safety of nuclear facilities[47].

The Netherlands have implemented European Council Directive 2011/70/Euratom establishing a community framework for the safe management of SF and radioactive waste. This Directive requires the allocation of responsibility to the bodies involved in the different steps of SF and radioactive waste management. In particular, the national framework shall give primary responsibility for the SF and radioactive waste to their generators or, under specific circumstances, to a LH to whom this responsibility has been entrusted by competent bodies. An example of the latter is COVRA which takes over responsibility after accepting SF or radioactive waste from LHs.

The Directive 2011/70/Euratom requires that each Member State shall establish and maintain national policies on spent fuel and radioactive waste management. Each Member State shall also have ultimate responsibility for management of the spent fuel and radioactive waste generated in it. It shall establish and maintain national policies and frameworks, and to assure the needed resources and transparency.

[43] Dutch: 'Nederlandse Voedsel en Waren Autoriteit', NVWA
[44] Dutch: 'Inspectie Leefomgeving en Transport', ILT
[45] Dutch: 'Inspectie Militaire Gezondheidszorg', IMG
[46] Signed on 28 September 2017
[47] Reference in Dutch: 'Regeling van de Minister van Infrastructuur en Milieu en de Minister van Sociale Zaken en Werkgelegenheid van 6 juni 2017, nr. IENM/BSK-2017/128532, houdende algemene regels inzake de nucleaire veiligheid van kerninstallaties (Regeling nucleaire veiligheid kerninstallaties)'

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

Nuclear facilities such as a waste storage facility like COVRA 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 RB is responsible for handling the licence applications and performing related review and assessment.

The RB is also responsible for review and assessment activities in relation with its oversight activities.

The RB may seek expertise by contracting 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

Consequences of the merger of former entities of the RB

The merger of several entities into the ANVS is a large improvement for the development and maintenance of the human resources in most disciplines. All primary functions of the ANVS benefit from that. On the other hand being a larger and independent entity, the ANVS needs to develop also its secondary supporting processes.

Disciplines and training

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. Recently it has been decided that the ANVS will also be responsible for assessing and advising about a number of financial issues, amongst others the financing of decommissioning. So this discipline is being developed. Other disciplines that are being developed further are Research & Development and Public Communication.

For areas in which its competence is not sufficient or where a specific in-depth analysis is needed, the ANVS has a budget at its disposal for contracting external specialists.

The ANVS cooperates with other national and regional authorities and organisations, like the industrial safety inspectorate, the inspectorate of health, several safety regions (including the regional fire brigades), provinces and communities, the national coordinator for terrorism and public safety, and the national crisis centre. Also cooperation takes place with inspectorates for the domain of road transport (dangerous good transport supervision at the ILT) and the domain of air transport (safety culture/safety management).

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, HERCA, WASSC, TRANSSC, NUSSC, RASSC, EPReSC, NEA/RWMC, CRPPH and several of its Working Groups.

ANVS 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.

Financial & Human Resources

From 2015 ANVS started with a dedicated budget within the national budget. The starting point of its budget was the sum of the budgets of the merged entities. The budget is awarded by the Minister of I&M and totals € 27 M. Of this budget about € 9.4 M is spent on contracted support provided by organisations like RIVM, GRS and NRG.

The role of the ANVS is growing. Therefore it was felt that the total number of staff to make a robust and sustainable independent authority was not yet sufficient. During the IRRS mission of November 2014, IAEA recommended to assess the sufficiency of the staffing levels of the regulatory body. In 2016 the tasks and costs of the ANVS were evaluated, including its required staffing level. Based on the assessments, the ANVS is allowed to expand its staff to 141 FTE, including the two members of the board. The aim is to achieve this in 2018.

20.2 Independence of regulatory functions

Independence in decision making

The ANVS as a RB is not in any way involved in energy policies. In the Dutch Cabinet, the Minister of Economic Affairs is responsible for this subject. The involvement of the ANVS with nuclear power is restricted to nuclear safety and radiation protection and associate issues. Development of energy policies is carried out by the Minister of Economic Affairs.

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.

The authority is transparent in its decision-making processes, which also positively promotes the perception of its independence. The reporting obligations of the authority contribute to that transparency.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 ANVS has documented decision-making processes. However, the ANVS is a learning organisation and attempts to constantly improve this processes. The reporting arrangements (described below) are instrumental in achieving perception of independence in decision making.

Reporting arrangements

The ANVS reports to the Minister of I&M about its functioning. The Minister of I&M sends ANVS-reports to Parliament on nuclear safety, radiation protection, management of radioactive waste and other issues subject to the Nuclear Energy Act. Everything reported in Parliament is immediately available on the government website www.overheid.nl and is therefore available to any interested party. The ANVS publishes an annual report.

Results of major studies, conducted under the authority of the ANVS are presented by the Minister of I&M to Parliament. In addition, Parliament can and will now and then require the Minister to report to Parliament on specific issues in which Members of Parliament may have expressed an interest.

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 and transparency of regulatory activities

Both the creation of the ANVS and its legal task to provide public information led to the recruitment of dedicated ANVS communication staff. This is a positive development and will aid the ANVS in meeting its objectives for openness and transparency. Legal requirements on transparency by the ANVS comes from several international sources (e.g. the EU-directives on Nuclear Safety, Management of radioactive waste and Spent Fuel and the BSS).

The ANVS has its own website www.anvs.nl. This is also instrumental in positioning the ANVS as an independent authority and communicating with relevant stakeholders. From 2015 till today the basic communication tools (website, intranet et cetera) have been developed and are continuously improved. Relations with national, regional and local stakeholders and press are gradually built. Special arrangements are now underway for the communication and reporting of incidents in neighbouring countries.

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 needed to award a licence. These need to be published in the Dutch Government Gazette ('Staatscourant'), 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[48] and in the Government Gazette after enactment by the parliament.

Announcements of new regulations have to be published in the Government Gazette.

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[49]. 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 licensing 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.

[48] www.overheid.nl

[49] Examples of such exceptions are concerns regarding national security, privacy, and confidentiality of company information submitted to authorities.

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 Netherlands has transposed Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations. One of the articles of the Directive states that the prime responsibility for nuclear safety lies with the LH. This includes the requirement to develop a institutional safety policy at the corporate level and pursue continuous improvement. In regulation transposing Directive 2014/87/Euratom it has been further stipulated that the responsibility for the safety of radioactive waste and spent fuel management cannot be delegated and includes responsibility for the activities of contractors and sub-contractors whose activities might affect the nuclear safety of a nuclear installation.

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, among others, 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. The associated licence covers both the safety of the facility as well as the safety of the waste or spent fuel.

Article 70 of the Nuclear Energy Act specifies that a licence issued according to this Act is personal. In case of a licence transfer this regulation requires that the new LH needs tot have the necessary expertise and reliability in relation to safety. Reliability in relation to safety can also be related to financial solvency.

From 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, within a maximum of two years. 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 RB has been empowered to impound such material and have it transferred to designated institutes, which are equipped and licensed to manage these materials.

For fissionable materials two institutes have been designated by a special decree[50]: NRG[51] in Petten and COVRA in Nieuwdorp. The same institutes as well as the RIVM in Bilthoven have been designated for the management of radioactive materials.

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

The adequacy of financial resources for decommissioning is addressed under Article 26 and is not discussed under 22(ii).

As explained in Section B 'Policies and Practices', one of the basic principles governing radioactive waste management 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. This principle is fulfilled by the fact that COVRA includes in its charges all estimated costs for processing, storage and geological disposal, on the basis of the state-of-the-art at that time. Moreover, the main producers of nuclear waste generally directly pay the construction costs of the buildings

[50] 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

[51] Nuclear Research & consultancy Group, NRG

in which the waste is stored, these construction costs are not included in the waste management tariffs. This applies for example to the HABOG en VOG-2.

Current arrangements

COVRA charges a (contractual) tariff for all phases of the management involved (including the operational costs for storage and disposal). With the implementation of Directive 2011/70/Euratom, the obligation to add a surcharge to the tariffs of COVRA for future research of disposal has been introduced. The final goal is to acquire the financial resources and knowledge needed to achieve geological disposal around 2130.

Due to economies of scale, it is envisioned that all radioactive waste (including high-, intermediate- and low-level radioactive waste) will be placed in a single final repository. The cost of management can be roughly subdivided into storage costs and the costs of geological disposal.

The cost of the above-ground management of radioactive waste at COVRA is estimated at approx. €7.5-8.5 million per year (excluding transport and processing costs).

The CORA (2001) research programme produced a cost estimate for geological disposal in salt and clay strata. The cost estimate for such a geological disposal will be updated in the current OPERA research programme. This research programme will deliver its final report in 2017. COVRA is currently working on the basis of a cost estimate for geological disposal of approximately €2 billion (source: COVRA 2016 annual report). The provision for final disposal currently on the COVRA balance sheet will increase in the period up to 2130 (based on the forecasts for income from waste producers, real growth and inflation) to an amount within the 25% bandwidth of the target amount.

Based on the ‘polluter pays’ principle, COVRA passes on the estimated costs for above-ground storage and final disposal in the rates it charges the waste suppliers. After payment of the tariffs, the financial liability is transferred to COVRA. The accumulated funds are projected to grow during the period of above-ground storage, to cover the costs of both storage and geological disposal. Allowance should be made for the fact that the provisions COVRA has included in the balance sheet reflect future liabilities in terms of real cost levels. Underlying assumptions are an average inflation rate of 2% and a real interest rate of 2.3%. These parameters translate into a target return of 4.3% on the financial resources for storage and geological disposal. These provisions and underlying parameters are periodically reviewed.

COVRA has several long-term contracts with major radioactive waste suppliers. Construction costs for the main buildings (e.g. HABOG and VOG-2) are paid for directly by the main producers. Details of the tariffs charged to small-scale suppliers are available to the public and can be viewed at COVRA’s website. These tariffs are corrected annually by the price index.

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 the Netherlands have relied on IAEA guidance on QA. The current guide is the 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 will be concluded in 2018. It is anticipated the GS-R-3 will be replaced by another IAEA guide, considering the development of the GSR Part 2 (2017).

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

Licence

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 RB.

Specific elements of the IMS of COVRA

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

- Internal policy statements of COVRA;
- 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 and flowchart of the processes as well as supporting information that explain how work is to be prepared, reviewed, carried out, recorded, assessed and improved.

Acceptance criteria

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, the basic legislation on nuclear activities in the Netherlands is the Nuclear Energy Act. A number of Governmental 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 activities and actions involving ionising radiation 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. With the implementation of the European basic standards (2013/59/Euratom) in February 2018, that expertise will be further secured. In particular, training for the supervisory expert will be extended to include knowledge of the specific application.

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 radioactive waste management facility is required to classify persons as radiation worker in one of the categories A or B based on the risk inventarisation and evaluation of all planned work tasks. This is needed for monitoring and supervision purposes. Category A workers are likely to receive doses greater than three-tenths of the dose limit for members of the public (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.

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 ANVS 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 data from the other approved dosimetric services were included. 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 2016 the highest individual dose recorded for the 65 radiation workers (48 COVRA and 17 external) was 2.8 mSv. The collective dose for these persons was about 33 man-mSv 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 7. 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 supervised and controlled areas. 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 7 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 β,γ	≤ 0.04 and ≤ 0.4
Green	Yes	≤ 0.025	and	α β,γ	≤ 0.4 and ≤ 4
Red	Yes	> 0.025	and/or	α β,γ	> 4 and/or > 40

Protection of the public

In 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 facility's perimeter. 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 COVRA the equivalent dose rate at the perimeter of the facility is as low as reasonably achievable (ALARA), but not higher than a fraction of the dose limit for the public. At specific locations at the perimeter of COVRA, gamma and neutron measurements are performed every month. The results of these measurements are corrected for background radiation and multiplied by the fixed factor related to the maximum period of time any person might conceivably be present at the site boundary. In 2016 the highest dose potentially received at any point at the fence was below 32 microSv/y. This is approximately 80% of the limit accorded to COVRA in the operating licence.

Both the LH (COVRA) and an independent institute (RIVM) monitor the gamma radiation levels at the border of COVRA continuously.

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 all of the events mentioned above.

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.

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.

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 8 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 factors. 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 6 and Figure 7.

Table 8 Authorized discharges at COVRA

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

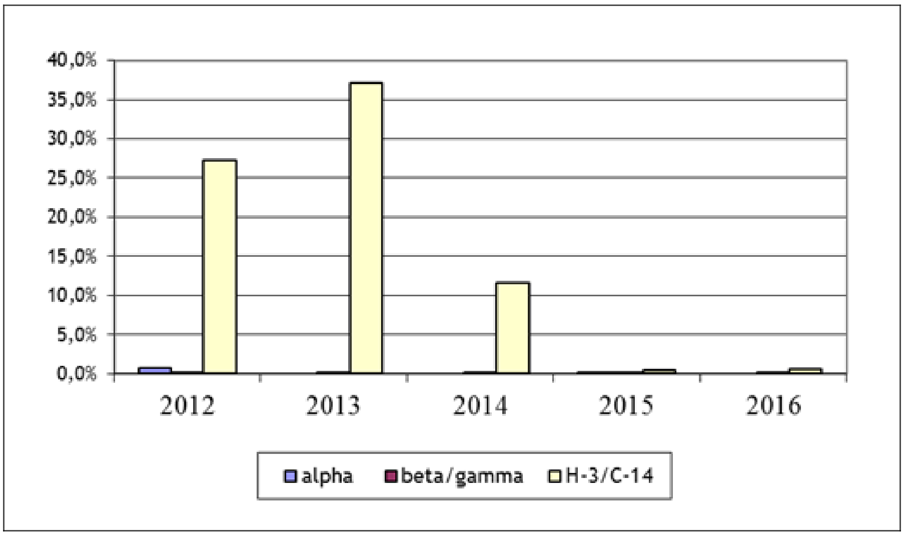

Figure 6 Emissions of radionuclides to the air as a percentage of the annual limit (source COVRA)[52]

[52] 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.

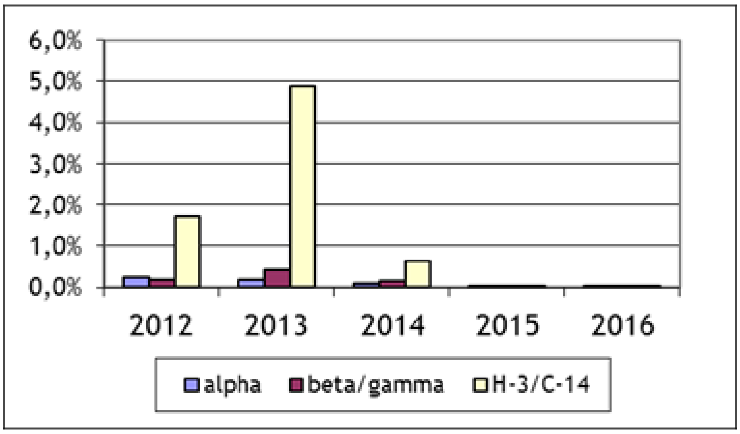

Figure 7 Emissions of radionuclides to water as a percentage of the annual limit (source COVRA).

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.

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 allocates the RB's responsibilities for preparedness and response for a nuclear or radiological emergency. The Dutch Safety Region Act details the responsibilities for emergency situations in general.

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 currently is not further elaborated in the national regulations[53]. 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.

25.1.a On-site emergency provisions

The licences for operation of spent fuel and radioactive waste management facilities stipulate that a on-site emergency 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 effectively 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 maximum radiation levels at the border of the facility. If these levels are exceeded, the RB must be notified.

25.1.b Off-site emergency provisions

Threat categories

A distinction is made between facilities where accidents could potentially have a 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 reactors. The COVRA facility is classified as a category B-object.

National nuclear emergency response plan

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. It also sets out the competences and the dependencies of the authorities that are responsible for nuclear emergency management (preparation and response).

Under Article 40 of the Act, the national government is responsible for the preparatory work and for actually dealing with any emergency that may occur in case of nuclear accidents. The operational structure of nuclear emergency preparation and response is based on Article 41 of the Act and is detailed in the National Crisis plan[54] for Radiation incidents: the NCS (Dutch: 'Nationaal Crisisplan Stralingsincidenten') and the 'Response Plan NCS'. The NCS describes the measures and mandates that are available to the national authorities during a nuclear or radiological accident. It refers to other related documents that address the management of nuclear and radiological accidents like the Response Plan NCS.

[53] After transposition of Council Directive 2013/59/Euratom (BSS), the update of the Radiation Protection Decree will be more specific with respect to this.

[54] Formerly known as National Nuclear Emergency Plan, NPK ('Nationaal Plan Kernongevallenbestrijding')

The Response plan NCS defines the roles and responsibilities of local/national government. It also describes the relationship with the regional arrangements of the Safety Region (Dutch: 'Veiligheidsregio'). For incidents with category A-objects, 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 accidents with category B-objects, the chairperson of the Safety Region or the mayor of the municipality, depending on the scope of the incident, is responsible for the emergency response. Incidents with category B-objects can be up scaled to category A. With this type of incident, local authorities can on request be advised by the national nuclear assessment team, the CETsn[55].

Local organisation for off-site emergency preparedness and response

Under Article 41 of the Act, the local authorities 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 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 those of the research reactors are not the most vulnerable part of these facilities.

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.

National full scale exercises have been held in 2005 and 2011. The next one will be in 2018.

Intervention levels and measures

For purposes of emergency planning, the generic intervention levels and measures of Table 9Table 1 are observed.

The intervention measures and levels have been established following discussions with national experts in the relevant fields. International expertise and guidelines were also taken into account. There are also derived intervention levels for foodstuffs, based on the appropriate EU regulations.

[55] Dutch: 'Crisis Expert Team – straling', CETsn

Table 9 Intervention levels and measures

Measure	Time[a)]	E (mSv)	H_{th} [b)] (mSv)	H_{rbm} [c)] (mSv)	H_{lung} [d)] (mSv)	H_{skin} [e)] (mSv)
Immediate evacuation [f)]	48 h	1000	5000	1000	4000	3000
Early evacuation [g)]	48 h	100 (50 – 100)[h)]				
Iodine thyroid blocking < 18 yr and pregnant women	48 h			50 (10 – 50)[h), i)]		
Iodine thyroid blocking persons 18 – 40 yr	48 h			100 (50 – 250)[h), i)]		
Sheltering	48 h	10 (5 – 15) [h)]				
Skin decontamination	24 h					50 [j)]
Skin decontamination with medical check	24 h					500 [j)]
Late evacuation	1 yr	50 – 250[k), l)]				
Relocation and return	50 yr[m)]	50 - 250				

a) Time is period after start release which is the basis for calculating the potential dose.

b) Thyroid dose

c) Bone marrow dose

d) Lung dosis

e) Skin dosis

f) Immediate evacuation: evacuation, even during passage of plume, the objective is to prevent deterministic effects

g) Early evacuation: evacuation with the objective to prevent (severe) stochastic effects. Preference is to evacuate before passage of the plume, otherwise after passage of plume.

h) The single number is the intervention level in case of incident in a Dutch nuclear installation, between brackets, the range which can be used for harmonisation with neighbouring countries.

i) Excluding ingestion.

j) Decontamination when skin dosis > 50 mSv. Above 500 mSv also medical check needed after decontamination.

k) Evacuation long after release, if external radiation from deposited materials gives rise to a considerable dose.

l) Dose in a year; including dose from passing plume.

m) Period is 50 years after return.

25.2 International aspects

The policy regarding planning zones has been evaluated, taking notice of the emergency planning policies in neighbouring countries. In case of an emergency in a neighboring country, the Netherlands will initially follow the protective actions of the accident country. In case of an emergency in the Netherlands we will base our protective actions on the Dutch policy of intervention levels. In order to do so, the planning zones have been aligned with that of the neigboring countries. Furthermore, a scale of intervention levels has been introduced. The default value within this scale is the intervention level that will be used in case of an accident with a nuclear installation in The Netherlands. In case of an incident in a neighboring country, intervention levels within the range can be used to link with the neighboring country. Also refer to Table 9 in section 25.1 of the present report.

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

Table 10 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	Safe enclosure till 2045	1997
High Flux Reactor (HFR), Petten	Research reactor	45 MW_{th}	Operational	N.a.
Low Flux Reactor (LFR), Petten	Research reactor	30 kW_{th}	Decommissioning ongoing	2010
Hoger Onderwijs Reactor (HOR), Delft	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 and is being decommissioned.

National policy

In principle the operator is responsible for all aspects of decommissioning. According to legislation, in force since April 2011, a nuclear facility shall be decommissioned directly after final shut down[56]. 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 (preliminary) 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 eventually becomes part of the decommissioning licence.

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

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

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 on the decommissioning will be stored at COVRA.

The 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 or in the event of unexpected closure of business. 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 state of Safe Enclosure for 40 years. As the plant reached a state of Safe Enclosure in 2005, a licence was granted to keep it in Safe Enclosure 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.

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 licence for Safe Enclosure of the NPP Dodewaard requires its operator to appoint a radiological expert for this period, who is responsible for all radiation protection issues. These responsibilities include:

- To assess 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[57] and is transferred at regular intervals to COVRA.
- To report periodically to the RB on radiation protection matters and general site conditions.

During the ongoing decommissioning of the LFR in Petten, these requirements also apply, but the applicable timeframe is much shorter than for the Safe Enclosure of NPP Dodewaard.

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 decommissioning. 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 five 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

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

whether the financial provision offers sufficient security that the decommissioning costs are covered at the moment of decommissioning.

26 (ii) Operational radiation protection

Emissions Dodewaard NPP

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[58] emissions of radioactivity will (per year) be restricted.

Table 11 Release limits of the NPP Dodewaard (in Safe Enclosure)

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 Dodewaard NPP

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.

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[59]. Waste quantities will be recorded and the records will 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 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).

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

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

In the case of the Borssele NPP, preservation of knowledge is less complicated, as the NPP will be dismantled directly after shut down. This is also true for the RRs. Furthermore, Dutch legislation requires that the operator keeps records 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 SF 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;

Ad a) The Netherlands has two Nuclear Power Plants (NPPs), a 485 MW_e net power pressurized water reactor in Borssele, which is in operation, and a 60 MW_e boiling water reactor in Dodewaard which has been shut down in 1997 and is now in a stage of Safe Enclosure. All SF has been removed from the Dodewaard plant and transferred to the UK for reprocessing. The last transport of SF 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.
The design of the NPP's SF pool complies with the provisions in Dutch safety guide NVR NS-G-1.4, which is an adaptation of IAEA Safety Guide Safety Standard Series No. NS-G-1.4, 'Design of Fuel Handling and Storage Systems in NPPs'. The 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.

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 applicable IAEA Safety Standards. This design of the fuel pool ensures the removal of residual heat from the spent fuel, while the design of the fuel storage racks ensures prevention of criticality.

Ad c) The HABOG facility of COVRA is designed to store spent fuel from the research reactors, vitrified waste and other high-level waste from reprocessing, research activities or molybdenum production. In November 2003 the first SF of the HFR reactor was stored, followed in 2004 by vitrified waste from reprocessing in France and by SF elements from the HOR. Transports of HLW take place at regular intervals. Currently, extension of the HABOG is taking place. For details of the HABOG design refer to 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 of SF is temporarily stored in the reprocessors' storage pools pending shearing. The SF of Borssele NPP 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.

Spent nuclear fuel mentioned under d) 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, the policy on the management of radioactive waste also applies to SF. Minimization of the generation of radioactive waste is part of this policy, refer to section 32.1 for more information. 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.

Regarding management of SF, the choice whether or not to reprocess spent fuel is left to the operator. The operators of the two NPPs Dodewaard and Borssele decided in favour of reprocessing. 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. Central government does the same every twenty years. Depending on these evaluations, a different strategy may subsequently be imposed on the licence holder.

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.

4 (iii) Interdependencies in spent fuel management

The basic steps in SF 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.

For SF management under 'pre-treatment' is meant the temporary storage with the aim of cooling down in the storage pool at the reactor site. Treatment is to be understood as reprocessing at a reprocessing plant as the one of AREVA in France. After SF has been shipped to the reprocessing plant, the SF is allowed to further cool for some five to eight years in pools. Then the fuel is removed and sheared into pieces for further processing. Solvents are used to separate uranium, plutonium and fission products. The fission products and other reprocessing residues are conditioned in packages that facilitate their long-term storage without significant maintenance. The fuel from the RRs is also packed in sealed canisters consistent with maintenance-free storage. The final step would be the geological disposal.

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 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 constraint 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).

All regulation regarding protection of the public and the environment, reported in the context of safe management of radioactive waste, also applies to the safe management of SF. For details refer to the text in sections 24.1 and 24.2, and the text under Article 19.

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, biological, chemical or other hazards are not considered to be a significant issue in spent fuel management.

At the HFR in Petten and the HOR 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, biological, 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 HLW 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, one of the principles on which the policy for the management of waste is based is safe management. Therefore the current policy in the Netherlands with regard to SF management of the NPP is not to use the full capacity of the storage pools for on site storage of SF. As required by a pertinent condition in the operation licences of the nuclear facilities, regular transports of SF from the NPP to the reprocessing plants are carried out to ensure that this favourable situation is being maintained.

For the SF of the research reactors the same approach applies. The clear objective is to limit as far as practicable the amount of SF in the storage pool at the reactor site. Regular transports of SF 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 SF is in the best position to provide for good management now and to offer possible and sustainable solutions for the future.

For SF 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. According to prevailing expert views, the HLW is already in a suitable condition for disposal.

SF from the research reactors will be conditioned, packaged and subsequently stored in the HABOG facility at COVRA.

The 'burden' for future generations is limited to execution of the final disposal Alternatively, if other options become available in the future, it would be the execution of these other, and presumably preferred, options for disposal. Until then, the care for these materials 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 the collected financial resources and technical knowledge required setting favourable conditions for the 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 SF. Some SF is kept in short-term storage in the SF pool at the Borssele reactor site, awaiting transport to the reprocessing facility. The management of SF of the Borssele NPP that is sent for reprocessing in France is exercised under the authority of the French government.

The only SF long-term management facility is the HABOG facility, managed by COVRA. This facility is designed to store SF from the research reactors and residues from reprocessing and has been commissioned in 2003. An upgrade of the safety of this facility is not applicable yet.

The ministerial decree on nuclear safety of nuclear installations[60] requires continuous improvement of (nuclear) safety and the execution of periodic safety reviews. In line with this, the LH of the spent fuel and radioactive waste management facility (COVRA) carries out periodic safety reviews as required by the licence:

- Every 5 years an assessment of the activities and accomplishments in the area of safety, waste management and radiation protection is performed against the licence requirements to conclude about eventual shortcomings and possibilities to improve;
- Every 10 years an comprehensive assessment is performed, where the design, operation, procedures and organisation is compared with current/modern (inter)national standards in order to find reasonably achievable improvements.

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 SF 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.

[60] Dutch: 'Regeling Nucleaire veiligheid kerninstallaties'

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 area. Many 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 SF 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 SF and waste storage facility for a generic site. The Environmental Impact Statement (EIS) 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 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). On both the EIS and the licence application the public could express its view.

Since SF management facilities can in principle give rise to discharges of radioactive materials and hence could possibly affect other countries, information on plans for new facilities or major modifications of such facilities is provided to the European Commission, which will have an assessment made by experts.

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

SF from the RRs and reprocessing residues are stored in the HABOG facility at COVRA. HABOG was commissioned in 2003. A schematic cross-section of the HABOG facility is presented in Figure 8.

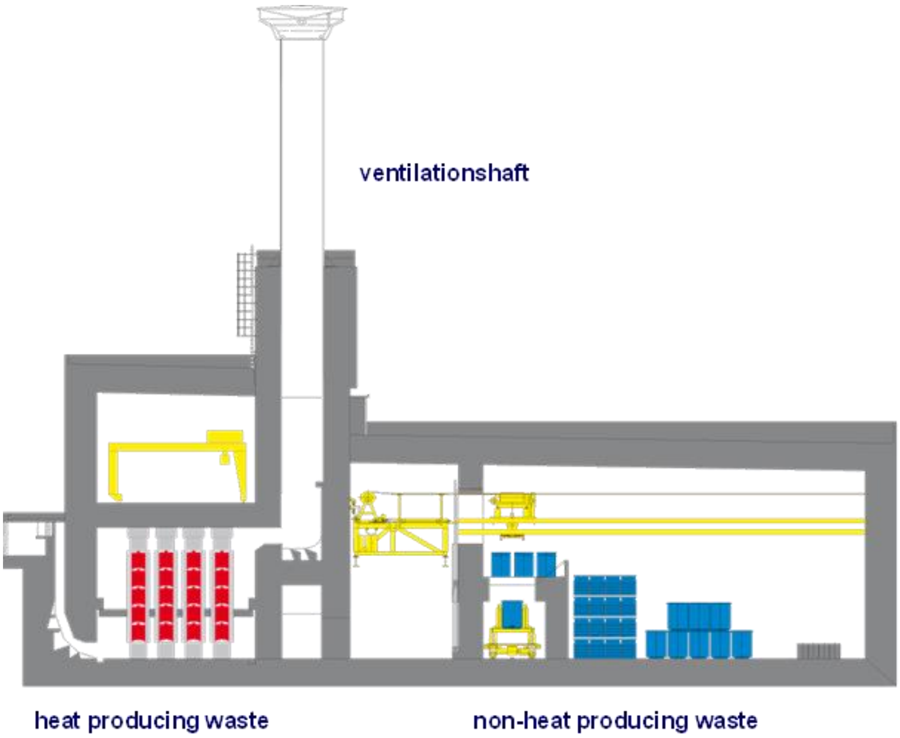

Figure 8 Cross-section of the HABOG facility

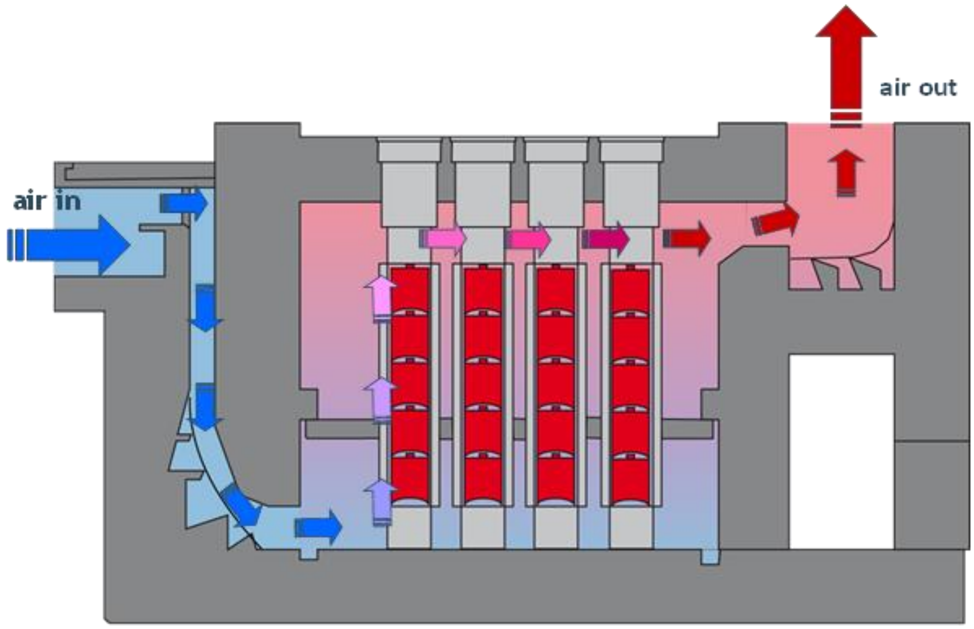

Figure 9 Storage wells for SF and HLW in the HABOG, with passive cooling

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 9.

The leading principles of operational safety in the management of spent fuel (and radioactive waste) are Isolation, Control and 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 underpressure. 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. Following the applicable decommissioning legislation, COVRA has a Preliminary Decommissioning Plan (PDP) approved by the authorities. The facility is designed and operated with the objective to prevent contamination, which will ease future decommissioning. The SF and waste packages accepted in the building have to be free of (non-fixed) contamination (IAEA Safety Standard SSR-6[61]). 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

[61] IAEA Safety Standards Series, Specific Safety Requirements, No. SSR-6, Regulations for the Safe Transport of Radioactive Material - 2012 Edition.

removed. Finally, the consequences of any contamination are limited by compartmentalisation.

7 (iii) Technologies incorporated in the design and construction

One of the important 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 SF 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 as 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 SF 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[62], 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 12.

Table 12 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 facilities at COVRA meet the descriptions under the entries a and d and an EIA had to be conducted. The first EIS for COVRA was published in 1985 (also refer to section 6.1). The most recent EIS was carried out in 2013 as a consequence of the extension of the HABOG facility and the building of a new storage building for depleted uranium (the VOG-2).

Both the EIS of 1985 and the subsequent EIS of 1995 and 2013 predicted that the envisaged activities of the COVRA facility would not cause any detrimental effect on the population and the environment.

The actual impact to the environment is even lower than assumed in the EIS, because all emissions of radioactive materials and chemical hazardous materials – both airborne and waterborne – remain 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.

In addition to the update of the EIS in 2013, in 2014 the Safety Report was updated as well.

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

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, the HABOG, 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 associated Safety Report. During the first operational phase, when the storage building was 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 fundamental review shall be conducted once every ten years. The latter may involve a review of the facility's 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 SF 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 SF 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 enter what is called its ‘passive phase’, in which no waste will be emplaced in HABOG. During that phase, maintenance and control will continue. After 2130 a final disposal route should become operational.

The provisions 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 has become 2052. A treaty signed by the Republic of France and the Kingdom of the Netherlands, regulates return of radioactive wastes from reprocessing to the Netherlands before 31 December 2052, as far as it concerns SF produced after 2015. COVRA has a comprehense ageing management programme, giving attention to aspects of ageing important for nuclear safety. This programme includes in-service-inspection, (preventive) maintenance, monitoring of compliance with acceptance criteria and documenting and learning from operating experience.

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. International operational expercience feedback is obtained by the RB from the IAEA FINAS database. The Netherlands is an active participant in FINAS Technical Meetings and workshops.

9 (vii) Decommissioning plans

Following the applicable decommissioning legislation, COVRA has a Preliminary Decommissioning Plan (PDP) approved by the authorities in 2012. The compulsory periodic update of the plan has recently been sent for approval to the authorities.

Decommissioning of the HABOG facility will not differ significantly from the demolition of any other robust building outside the nuclear sector.

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 (SF)

The SF 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. Geological disposal is envisaged around 2130.

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

All radioactive waste in the Netherlands is treated and stored at one central radioactive waste management facility: the COVRA waste treatment and storage facility. 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 as well as buildings for the storage of depleted uranium oxide from the Urenco enrichment plant in Almelo. The waste treatment building for LILW 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 whole waste management facility has received a major regulatory overhaul in the framework of a revision of the licence (issued 2015) which among others covered the extension of HABOG and construction of the VOG-2 building.

Under the operating licence of COVRA there is a condition to have periodic safety reviews. Refer to the text under Article 5 for details.

A second and older radioactive waste management facility is located at the research location Petten. This Waste Storage Facility is operated by the company NRG and was used for several years as a national waste management facility before COVRA was in operation. Nowadays, this location still holds a certain amount of legacy radioactive waste. This waste, resulting from four decades of nuclear research at that location, exists mainly of activated metals and high active laboratory equipment. Part of the waste is also containing fuel material residues (fissile materials and fission products). The majority of the historical waste is stored in 1,765 metal drums placed inside concrete-lined pipes, a smaller amount is and stored in concrete trenches.

For the intermediate- and high-level waste present in the Waste Storage Facility, 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 the end of 2022.

12 (ii) Past practices

The Waste Storage Facility (WSF) in Petten was used as a central radioactive waste management facility from the late 1970s until the COVRA facilities in Nieuwdorp were erected in the 1990s. Before that, the WSF was already used as the storage facility for the research location Petten since the early 1960s. During the 1990s, all drums containing low and intermediate level waste were transported to the COVRA facility. The high level mixed waste that could not be transported directly without repackaging and treatment remained in Petten.

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 several 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. Between 2014 and 2016, all drums containing that were known or expected to contain PVC (based on archived information), about 130 in total, were be sorted, repacked, and prepared for storage at COVRA. The PVC was removed from the highly active waste and repackaged separately. All other legacy waste will also be sorted, 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 the end of 2022.

The legacy waste emplaced in the WSF before 1998 is owned by ECN. In the period 1998 - 2001 waste was emplaced that can also be considered as legacy waste and which is owned by NRG. Basically, the management costs - including the commissioning, operation and decommissioning of the necessary facilities where the waste will be treated and repacked before transportation to COVRA, have to be paid by the owners of the legacy waste. The costs are divided according to the volume ratio of the waste. Part of the waste will be transported to Belgium for compacting and conditioning, before it is stored at COVRA. In the meantime, a project is running to determine the most efficient method for transferring the waste to COVRA. The management of the legacy waste and the transfer of this waste to COVRA is licensed in the license of NRG.

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 the dissolved radioactive material is deposited with chemical agents or by electrochemistry as far as possible. 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 solid waste*
  Most of the volume of radioactive waste collected by COVRA is compactable solid 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 that cannot be returned to the producer 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.

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 VOG and the new VOG-2 (opened in 2017) 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.

For more information on these buildings refer to Annex 1.

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 potential radiological impact is limited.

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[63] 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 should be possible for a certain period of time.

The overriding reasons for introducing the concept of retrievability were derived from considerations of sustainable development. Waste is considered a non-sustainable

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

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 – 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[64]. 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. The optimum period of retrievability will be assessed in consultation with society. In the Netherlands only salt and clay are available as possible host rock for a geological disposal facility.

Since the Netherlands has adopted the strategy of long-term storage in dedicated buildings at the surface till 2130, there is no immediate urgency to resolve this matter.

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.

[64] 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 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.

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. After the period of longterm storage, geological disposal is foreseen around 2130. The decision-making therefore is expected around 2100.

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 transferral of radioactive waste to COVRA is a financial incentive for LHs 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 around 2130. The decision-making therefore is expected around 2100. 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[65] Council Directive nr. 2006/117/Euratom[66]. This directive sets out

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

similar requirements as the ones specified in paragraphs (i)-(v) of article 27 of the Joint Covention.

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

Spent fuel destined for reprocessing is not considered to be radioactive waste. However, with a view to the large quantities and high radioactivity levels of this material involved in such transports, these shipments are now also part of Directive 2006/117/Euratom and need an import and export license.

In addition in the Netherlands a transport licence is required based on the Nuclear Energy Act. The transport shall be in compliance with the international transport regulations 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.

Concerning 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[67,68,69,70,71] are not affected by the Joint Convention.

[66] 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.

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

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

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

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

[71] 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[72] and implemented in the national Transport Decree, Radiation Protection Decree and subordinate regulation, must be licenced. 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. Transport of disused sealed sources usually does not require a licence but is subject to notification of the ANVS.

Council Directive 2003/122/Euratom[73] aims to further restrict exposure of the population to ionizing radiation from high activity sealed sources (HASS), including orphan sources. This Directive requires that the possession and use of 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. After Council Directive 2013/59/Euratom comes into force (February 2018), the transport of HASS will require a licence.

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. Operators working with large volumes of scrap or highly active sources have statutory obligations for securing the management of these radioactive sources.

The competent authorities, the ANVS, the Inspectorate for Social Affairs and Employment (I-SZW) and the State Supervision of Mines (Sodm) inspect on compliance with

[72] 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

[73] 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

legislation and regulations regarding sealed sources. Their scope covers safety and security aspects.

Registering, monitoring and detection of sources

ANVS maintains a database of the licences of holders of all sources of ionizing radiation. New information received through 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[74]. 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. To prevent this the melters do have portal detectors as well.

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 the scrap, in many cases only the contaminated part, 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 preferred alternative 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. Within 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[75] 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.

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

[75] 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 challenge is 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. COVRA is responsible for the preservation of the information on the stored waste during the long-term interim storage period.

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 long-term storage period. Additional expertise could be hired from support organisations in the Netherlands and abroad.

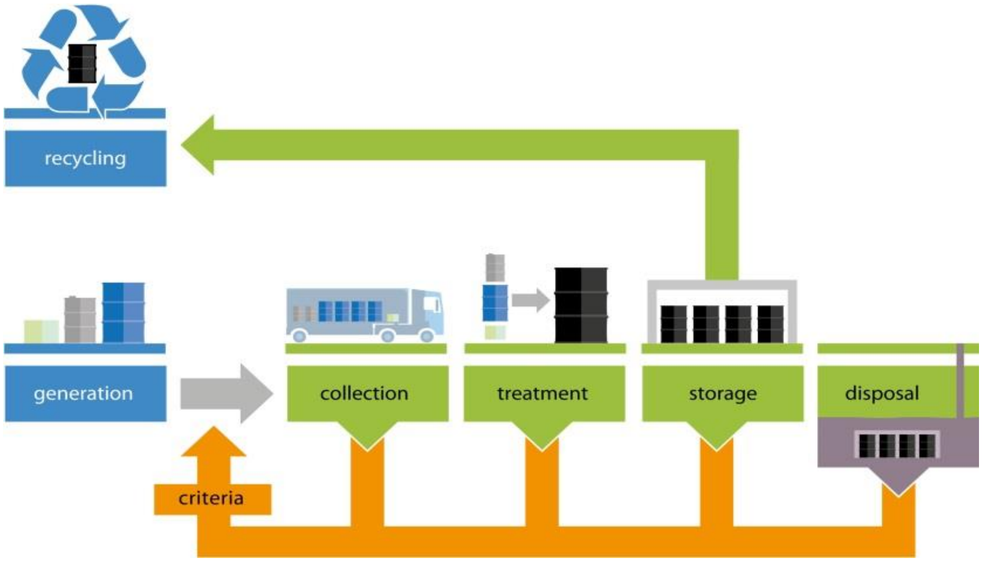

Figure 10 Knowledge on the various steps of the radioactive waste management chain needs to be preserved

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 update of this information at regular intervals is assured. Paper information carriers are printed on certified durable paper and ink and stored in a conditioned room.

Maintenance of nuclear competence at the Regulatory Body

The main themes addressed at the fifth Review Conference have been addressed in the Introduction to the present report. An important theme is the supply in adequate numbers, of suitably qualified and experienced staff for the RB. Recently the RB staffing has been enlarged from about 90 FTE to about 130 FTE to be further increased to 141, including the two members of the board. Furthermore the staff receives dedicated training. The recent 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.

Other efforts of importance

The way the challenge to maintain competence at the RB and at COVRA is met, has been addressed above but also in the Introduction of the report.

Measures taken to address suggestions and challenges identified at the previous Review Meeting can be found in the Introduction of the national report.

Information on the actions taken to enhance openness and transparency in the implementations of the obligations under the Convention can be found amongst others in section 20.2 'Independence of regulatory functions'.

The Netherlands has hosted various international missions at its nuclear facilities but also has hosted an IRRS mission in November 2014. The IRRS follow-up mission is planned for 2018. An ARTEMIS[76] mission is planned together with the next IRRS-mission in 2023. Results of such missions are made available to the public. Refer to the national report for the Convention on Nuclear Safety[77] (CNS) and especially its Appendix 8 'missions to Nuclear Installations and the RB' for details. Experts of the ANVS participate and contribute to IAEA missions in other countries.

[76] ARTEMIS is an integrated review service for radioactive waste and spent fuel management, decommissioning and remediation programmes, developed by the IAEA.

[77] Published in 2016.

Section L Annexes

Annex 1 Interim Waste Storage Facilities

COVRA has a site 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. The available site offers enough space for the waste expected to be produced in the Netherlands in the next hundred years up to the final disposal. A layout of the COVRA facilities as present today, is given in Figure A.1.

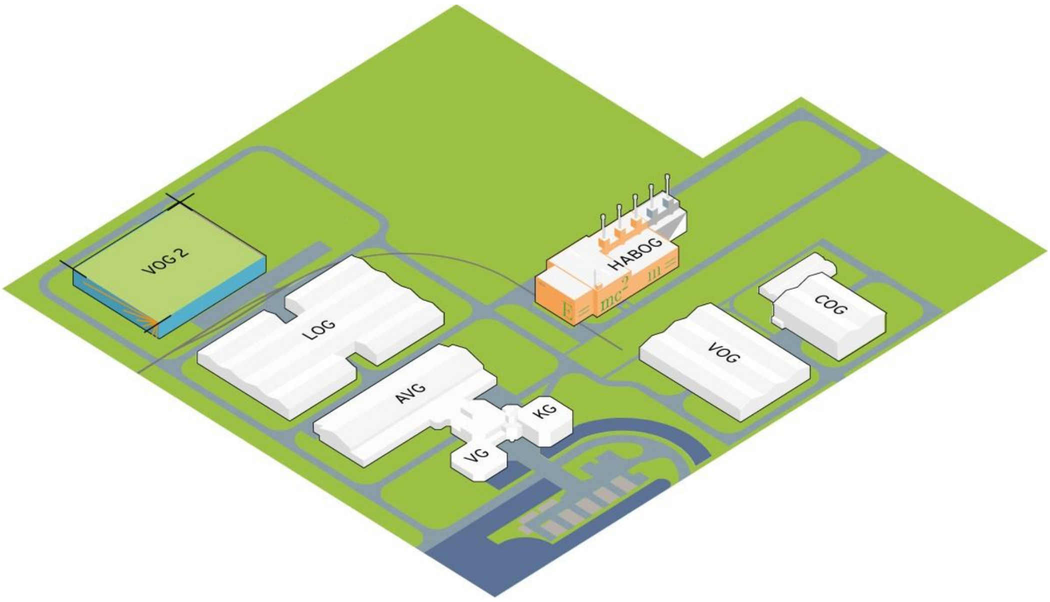

Figure A.1. Layout of the COVRA facilities.

KG & VG – office building and exhibition centre;

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

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

HABOG – storage building for high-level waste (being extended);

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

VOG & VOG-2 – storage buildings for depleted uranium.

All storage facilities are modular buildings. The storage building for low- and intermediate-level waste is H-shaped (LOG 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.

There is a storage building for NORM[78] waste (COG) and one more building of approximately the same size could be constructed in the future. The storage building for depleted uranium waste is the VOG. A second building VOG-2 has been constructed to accommodate the generation of the depleted uranium from 2017 on. The artist William Verstraeten created again a spectacular new work. The building is the largest sun dial of Europe, indicating the phenomenon of time as important factor to render radioactivity harmless.

[78] Naturally Occuring Radioactive Material, NORM

The storage building for high-level waste (HABOG) is being extended. This is necessary because of the Long Term Operation of NPP Borssele.

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

LILW is treated 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;
- make identification possible to know the content;
- 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 1000 litre containers.

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

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

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. 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 prevent water entering the building.

NORM and depleted U

The NORM 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. 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%. As all containers must be free of outside contamination according to normal transport requirements, no contamination is present inside the building.

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. The building can be expanded modularly 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

Vitrified waste and compacted hulls and end caps are and will be returned to the Netherlands after reprocessing of spent fuel. The research reactors as well as the molybdenum production facility in the Netherlands produce SF and other high-level waste. A packaging and storage facility is in operation for high-level waste. 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 wells during construction

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

The choice for 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. SF 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 RB, 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 $E=hv$. Designed to last for up to 300 years, it contains the waste resulting from the reprocessing of the spent nuclear fuel from the Dutch nuclear power stations Borssele and Dodewaard as well as spent fuel from research reactors and the spent uranium targets of molybdenum production.

The radioactivity of the waste inside HABOG will decrease in time through decay. This process is symbolised by the changing 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.

Therewith HABOG is more than an interim storage, it is a communication tool. It helps to explain the concept of radioactivity in a 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.

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". That offers 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. 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. That is why 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 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 building for storage of depleted uranium as well as the extension of the HABOG offer further opportunities to interest the public. To start a dialogue and to give a positive image of radioactive waste. This is why COVRA designs buildings to be a thing of beauty. To use the 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 be a sundial.

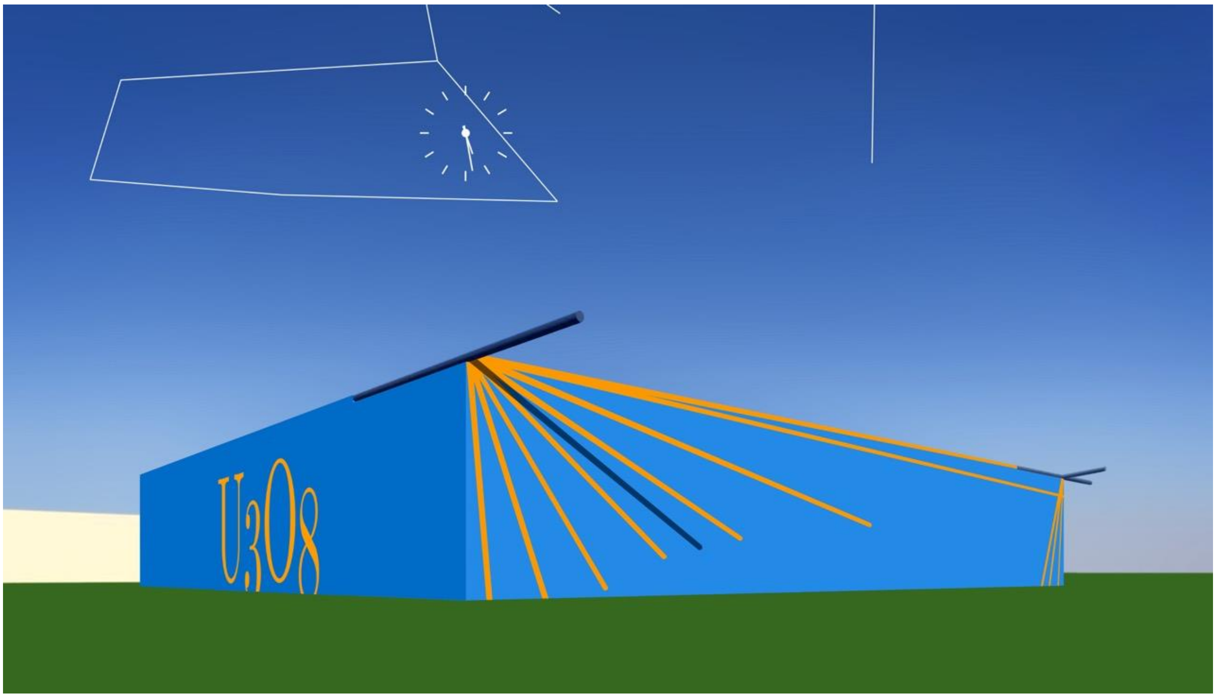

Figure A.7 Second depleted uranium building: the largest sundial of Europe

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.

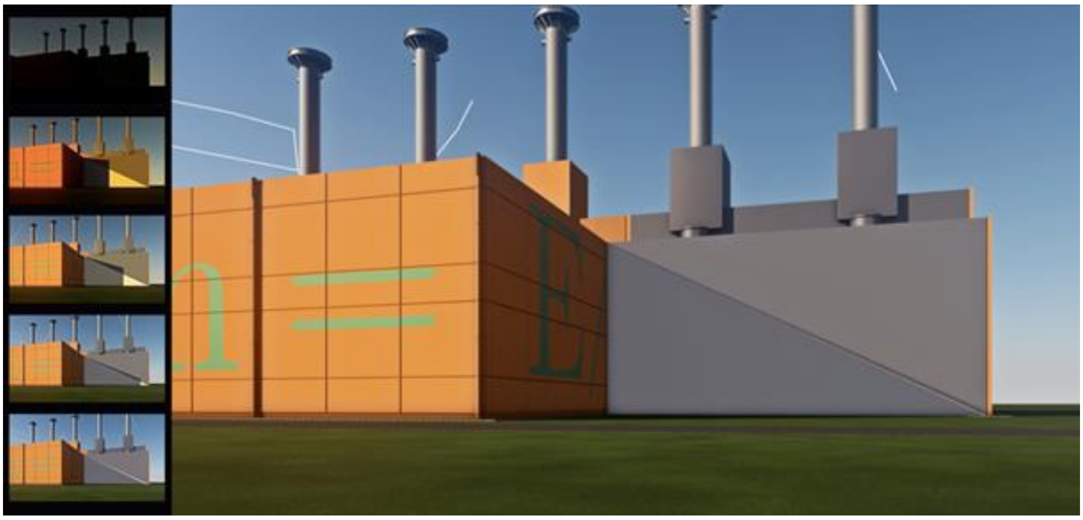

Figure A.8 Visual play of sun on the extension of HABOG occurring twice a year

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.

Annex 3 International orientation and collaboration

In developing and designing Dutch policy on radioactive waste, regulations and supervision, European and other international frameworks are closely followed. Furthermore, on a voluntary basis, links are sought with internationally-accepted principles, recommendations, practices and agreements as established under the flag of the International Atomic Energy Agency (IAEA), Heads of the European Radiological protection Competent Authorities (HERCA) and the Western European Nuclear Regulators Association (WENRA).

The competent authority participates in a number of international organisations involved in the harmonisation of the policy on radioactive waste: the European Community for Atomic Energy (EURATOM), the European Nuclear Safety Regulator Group (ENSREG), the Western European Nuclear Regulators Association (WENRA), the Nuclear Energy Agency (NEA) within the Organisation for Economic Cooperation and Development (OECD) and the IAEA of the United Nations.

To guarantee that radiation protection remains 'state of the art', both the competent authority and COVRA participate in international peer review mechanisms. Furthermore, Dutch policy on the management of radioactive waste and spent fuel is periodically assessed by other countries, in the framework of the Joint Convention treaty under the flag of the IAEA and the EU directive 2011/70 Euratom.

Within the European Union, there are a number of collaborations in respect of disposal. The Netherlands is a participant in or has participated in a number of these. Below are a few examples:

- IGD-TP
  COVRA and its contractors participate in the technology platform IGD-TP (Implementing Geological Disposal of Radioactive Waste Technology Platform (http://www.igdtp.eu/) a European collaboration for disposal in geological layers.
- ERDO working group
  In the dual strategy currently being followed by the Netherlands towards disposal, international collaboration has been sought within the ERDO working group (European Repository Development Organisation-working group, http://www.erdo-wg.eu/Home.html). This working group exchanges knowledge and addresses the common international challenges in managing radioactive waste. Possibilities are also being investigated of establishing a European waste management organisation.
- SITEX
  SITEX (Sustainable network of Independent Technical EXpertise for radioactive waste Disposal, http://www.sitexproject.eu) was a project in the framework of the seventh framework programme from Euratom. The follow-up programme SITEX II has been introduced and the TSO NRG the Netherlands participates in its activities. The aim of SITEX is to strengthen and harmonise technical expertise in respect of disposal within the regulatory authorities and the supporting organisations.
- ENSREG WG-2
  Working Group 2 on Waste Management and Decommissioning endeavours to improve the safety of the management of spent fuel and radioactive waste and decommissioning in the European citizen interest. It strives to identify elements, approaches and measures for a continuous improvement of the safe management of spent fuel and radioactive waste and of the decommissioning, to strengthen cooperation, to promote joint effort in building and maintaining competence and knowledge, It provides guidance to facilitate the implementation of EU legislation in the field of nuclear waste safety.
- WGWD/WENRA
  The working group on waste and decommissioning (WGWD) is mandated to analyse

the current situation and the different safety approaches, compare individual national regulatory approaches with the IAEA Safety Standards, identify any differences and propose a way forward to possibly eliminate the differences. The proposals are expected to be based on the best practices among the most advanced requirements for nuclear waste facilities.

Annex 4 History of development of the policy and the research programme

Short history of the development of the policy

For more then thirty years the Dutch policy on radioactive waste has been based on the aboveground storage of radioactive waste at COVRA for at least 100 years, after which disposal in deep belowground is envisaged.

The basis for the current policy on managent of SF and radioactive waste management is a report presented by the Government to parliament 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 the geological disposal of the waste. It also defined the principles on which the current policy is still based: minimizing occurance of radioactive waste; safe management of radioactive waste; no unreasonable burdens on the shoulders of future generations and producers of radioactive waste must bear the costs for the management of that waste.

The report led to the establishment of the national waste management organisation, the COVRA in Nieuwdorp, 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 its Regulatory body and COVRA kept and keeps institutional control over all SF and 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.

In 1993 the government adopted a position paper on geological disposal which introduced the requirement of retrievability of the waste during the use of the facility.

Later the idea of a dual strategy was introduced: the Netherlands should be able to establish its own geological disposal facility but when the opportunity arises, an international cooperation (with shared facilities) must also be possible. In 2015 this was documented in the national programme, together with a date at which a geological facility must have been established (2130).

Short history of the national research programmes into safe long-term management of radioactive waste and spent fuel

The Netherlands has a history of more than four decades of research into the long-term safe management of spent fuel and radioactive waste. Results from the programmes have been used as input to the development of the policy on the safe management of spent fuel and radioactive waste.

Considerable research efforts started as early as 1976. The current research programme OPERA is in its final stage.

Notable programmes were:

- 1976 – 1979, Desktop studies performed by RGD (predecessor of TNO, geological branche) and RCN (predecessor of NRG). A research programme was conducted regarding the disposal of radwaste in rock salt, also supported by some exploratory drilling.
- 1984 – 1988 OPLA Phase-1. After the 1984 note on radioactive waste management, start of programme 'OPLA' concerning disposal in rock salt formations "on land", consisting of three consecutive phases: (1) feasibility; (2) exploratory drilling; (3) underground research lab.

- 1990 – 1993 OPLA Phase-1a. Probabilistic Safety Assessment (PROSA) concerning the disposal of radioactive waste in rock salt formations.
- 1995 – 2001 CORA programme. Development and comparison of retrievable disposal options, mainly in rock salt and clay.
- 2011 – 2017 OPERA Programme. Evaluation of existing safety and feasibility studies.

In 1993 the OPLA 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, the abovementioned 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 should 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, should still be possible for decades up to several centuries. Retrievability leaves future generations the possibility to apply other management techniques. The reasons for introducing this concept of retrievability originated from considerations of sustainable development. The retrievable emplacement of the waste in the deep underground would ensure a safe situation in case of neglect of maintenance 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 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 receive 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 long-term storage in dedicated surface facilities, there was and is no immediate urgency to select a specific disposal site. However, further research was and 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. The CORA committee recommended validation of some of the results of safety studies, under field conditions. Also co-operation with other countries, particularly on joint projects in underground laboratories was 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.

In July 2011 the current national research programme on radioactive waste, OPERA, started. COVRA has been charged to conduct this 10 million euro research program while the costs are equally 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 and the costs 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 end of 2017.

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