Ministry of Infrastructure
and Water Management

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 Seventh Review Meeting (25 May – 4 June 2021)

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Abbreviation	Full term	Translation or explanation (in brackets)
ALARA	As Low As Reasonably Achievable	
ANVS	Autoriteit Nucleaire Veiligheid en Stralingsbescherming	Authority for Nuclear Safety and Radiation Protection
Awb	Algemene wet bestuursrecht	General Administrative Act
Bbs	Besluit basisveiligheidsnormen stralingsbescherming	Basic Safety Standards Radiation Protection Decree
Bkse	Besluit kerninstallaties, splijtstoffen en ertsen	Nuclear Installations, Fissionable Materials and Ores Decree
Bvser	Besluit vervoer splijtstoffen, ertsen en radioactieve stoffen	Transport of Fissionable Materials, Ores, and Radioactive Substances Decree
Bq	Becquerel	
CETsn	Crisis Expert Team straling en nucleair	Crisis Expert Team – radiological and nuclear
COG	Container Opslag Gebouw	Container Storage Building
Conventional waste		Waste substances as intended in the Environmental Protection Act (or non-radioactive waste)
COVRA	Centrale Organisatie Voor Radioactief Afval	Central Organisation for Radioactive Waste
Directive 2011/70/ Euratom	Directive 2011/70/Euratom of the European Council dated 19 July 2011 on the establishment of a community framework for the responsible and safe management of spent fuel and radioactive waste	
EIA	Environmental Impact Assessment	
EPZ	N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland	(Licence holder, owner and operator of Borssele NPP)
EZK	(Ministerie van) Economische Zaken en Klimaat	(Ministry of) Economic Affairs and Climate Policy
€	Euro	
GKN	Gemeenschappelijke Kernenergiecentrale Nederland	(Licence holder, owner and operator of Dodewaard NPP – in Safe Enclosure)
GRS	Gesellschaft für Anlagen- und Reaktorsicherheit	(German Technical support Organisation)
HABOG	Hoogradioactief AfvalBehandelings- en Opslag Gebouw	High-level Waste Treatment and Storage Building
Heff	Effective dose equivalent	
HEU	High Enriched Uranium	
HFR	Hoge Flux Reactor	High Flux Reactor (Research Reactor in Petten, tank-in-pool type, 45 MWth)
HLW	High-Level Waste	
HOR	Hoger Onderwijs Reactor	(Research reactor of the Delft University of Technology)
IAEA		
	International Atomic Energy Agency	
IandWM	(Ministerie van) Infrastructuur en Waterstaat	(Ministry of) Infrastructure and the Water Management
IGJ	Inspectie Gezondheidszorg en Jeugd	Health and Youth Care Inspectorate
ILT	Inspectie Leefomgeving en Transport	Human Environment and Transport Inspectorate of the Ministry of Infrastructure & Water Management
IMG	Inspectie Militaire Gezondheidszorg	Inspectorate for Military Healthcare
IRRS	Integrated Regulatory Review Service	
ISZW	Inspectie SZW	Inspectorate SZW
JRC	Joint Research Centre of the European Communities	
Kew	Kernenergiewet	Nuclear Energy Act

Abbreviation	Full term	Translation or explanation (in brackets)
LEU	Low Enriched Uranium	
LFR	Lage Flux Reactor	Low Flux Reactor (Research reactor in Petten, decommissioned in 2019)
LH	Licence Holder, licencee	
LILW	Low- and Intermediate-Level Waste	
LNV	(Ministerie van) Landbouw, Natuur en Voedselkwaliteit	Ministry of Agriculture, Nature and Food Quality
LOG	Laag- en middelradioactief afval OpslagGebouw	Low- and intermediate-level Waste Storage Building
MOX	Mengoxide	Mixed Oxide
MWe	Megawatt electrical	
MWth	Megawatt thermal	
National programme		The national programme for the responsible and safe management of spent fuel and radioactive waste
NCS	Nationaal Crisisplan Stralingsincidenten	National Emergency Plan for Radiation Incidents
NDRIS	Nationaal DosisRegistratie en Informatie Systeem	National Dose Registration and Information System
NORM	Naturally Occurring Radioactive Material	
NPP	Nuclear Power Plant	
NRG	Nuclear Research and consultancy Group	(Subsidiary of the ECN Foundation, and licence holder and operator of the HFT)
NSD	Directive 2009/71/Euratom, 'Nuclear Safety Directive'	
NVR	Nucleaire VeiligheidsRegels	Nuclear safety rules (in the Netherlands)
NVWA	Nederlandse Voedsel- en Warenautoriteit	The Netherlands Food and Consumer Product Safety Authority
OPERA	OnderzoeksProgramma Eindberging Radioactief Afval	National Geological Disposal Research Programme
OVV	Onderzoeksraad voor Veiligheid	Dutch Safety Board
QA	Quality Assurance	
RB	Regulatory Body	
RID	Reactor Institute Delft	(Operator of the HOR research reactor in Delft)
RIVM	Rijksinstituut voor Volksgezondheid en Milieu	National Institute of Public Health and the Environment (the Nether-lands)
RR	Research Reactor	
SAR	Safety Analysis Report	
SF	Spent Fuel	Fission material that has been irradiated and permanently removed from a reactor core
Sodm	Staatstoezicht op de Mijnen	State Supervision of Mines
Sv	Sievert	
SZW	(Ministerie van) Sociale Zaken en Werkgelegenheid	(Ministry of) Social Affairs and Employment
URENCO	Uranium ENrichment Corporation Ltd	
VOG	Verarmd uranium Opslag Gebouw	Storage Building for Depleted Uranium
Wabo	Wet algemene bepalingen omgevingsrecht	Environmental permitting (general provisions) act
Wm	Wet milieubeheer	Environmental protection act
Wvr	Wet veiligheidsregio's	Security Region act
Ww	Waterwet	Water act
WSF	Waste Storage Facility	Waste storage building for legacy waste in Petten
zbo	Zelfstandig bestuursorgaan	Independent administrative body

Section A Introduction

This section sets out the purpose and structure of the present report, and it continues with an overview of the national nuclear programme. It also gives an overview of the main developments since the previous report to the Joint Convention (sixth report in 2017) and presents an update on the main challenges identified at the review meeting of the Joint Convention in 2018. This section ends with the overview matrix of liabilities and current policies and practices in the Netherlands.

Purpose of the national Joint Convention report

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management[1] (hereafter: Joint Convention or JC) 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.

On 10 March 1999, the Netherlands signed the Joint Convention, which was subsequently formally ratified on 26 April 2000 and entered into force on 18 June 2001. This report is the seventh 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 2020 unless explicitly specified otherwise. Updates to the information presented in this report may be provided at the review meeting in May/June 2021.

Structure of the national report

The national report for the Joint Convention follows closely the structure as suggested in INFCIRC/604/Rev.3, "Guidelines regarding the form and structure of national reports". When 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[2]

In the European Union, Council Directive 2011/70/Euratom (hereafter: the Directive) establishes a community framework for the responsible and safe management of spent fuel and radioactive waste. 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

[1] https://www.iaea.org/topics/nuclear-safety-conventions/joint-convention-safety-spent-fuel-management-and-safety-radioactive-waste.

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

now and in the future. The Netherlands published its national programme in 2016. Article 14 of the Directive obliges EU Member States to publish a national report on the implementation of the Directive, for the first time by 23 August 2015, and every three years thereafter. In 2018, the Netherlands published the latest 'National Report for the Council Directive 2011/70/Euratom'.

In 2019, the Netherlands published its national report for the Convention on Nuclear Safety (CNS). This report demonstrates that the Netherlands has developed, and continues to improve, a robust domestic framework for nuclear safety in line with its international obligations. All of these reports, including this nation report, are available for the public.

National nuclear programme

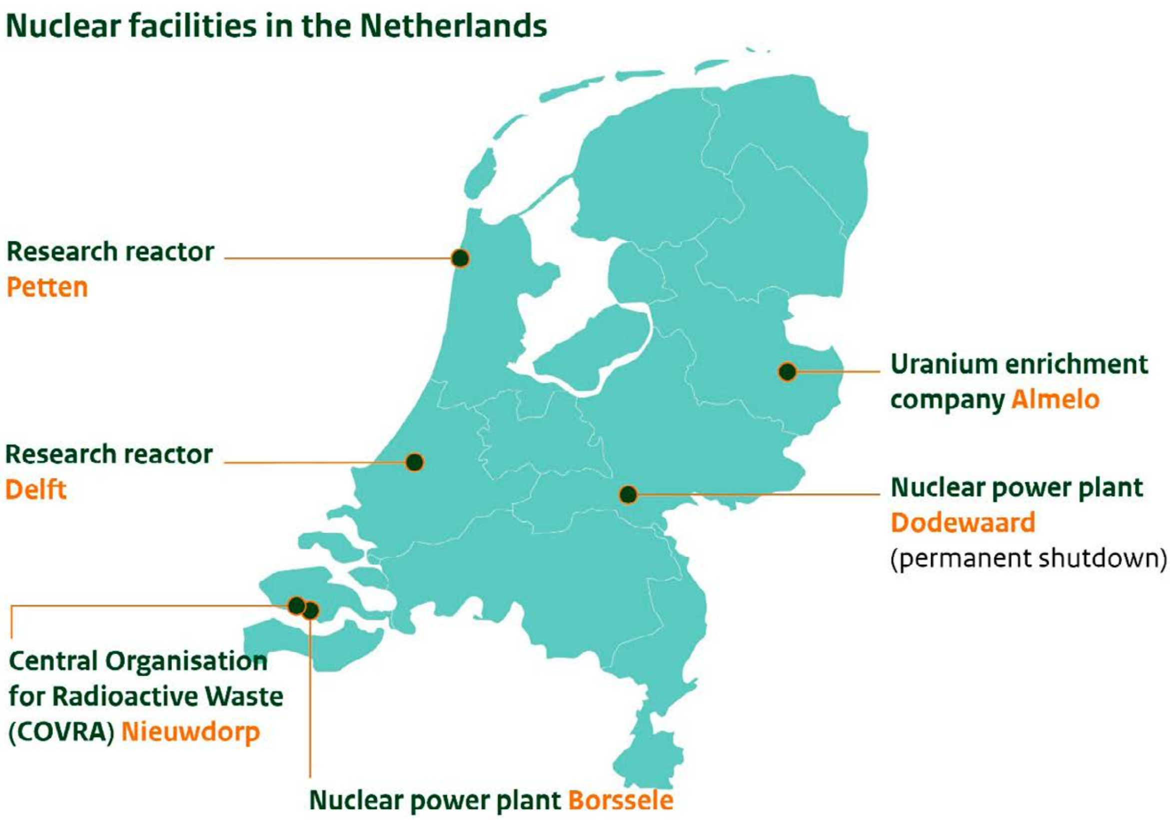
The Netherlands has a small but divers nuclear programme:

- One nuclear power plant (NPP) in operation: the Borssele Pressurized Water Reactor (Siemens/KWU design, net electrical output approximately 490 MWe), operated by N. V. Elektriciteits-Produktiemaatschappij Zuid-Nederland (EPZ).
- One NPP in decommissioning: the Dodewaard Boiling Water Reactor (GE design, 60 MWe), operated by Gemeenschappelijke Kerncentrale Nederland (GKN), was shut down in 1997, and is now in 'Safe Enclosure'.
- There are two research reactors in operation:
  - the High Flux Reactor (HFR, 45 MWth) 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 MWth) at the Reactor Institute Delft (RID), of the Delft University of Technology. One research reactor has recently been decommissioned: the Low Flux Reactor (LFR, 30 kWth) on the Research Location Petten was taken out of operation in 2010 and was decommissioned in 2019.

One uranium enrichment company: Urenco Netherlands has facilities for uranium enrichment in Almelo. Licenced capacity is currently 6200 tSW/a.

One national Waste Management Organisation (WMO): Central Organisation for Radioactive Waste (COVRA). COVRA is located at one site in Nieuwdorp and has facilities for the long-term 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 NPP Borssele. COVRA also manages radioactive waste from non-nuclear origin.

Figure 1: Locations of nuclear installations in the Netherlands



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

Recent developments since last Review Meeting

Recent developments of the regulatory framework

The basic legislation governing nuclear activities is contained in the Nuclear Energy Act ('Kernenergiewet' or Kew). The Kew 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 Regulations. Some Decrees associated with the Nuclear Energy Act contain additional regulations related to the use of nuclear technology and materials.

A significant update in legislation is the transposition of Council Directive 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation (BSS), in national legislation. On February 6 2018, the Decree on Basic Safety Standards for Radiation Protection (In Dutch: "Besluit basisveiligheidsnormen stralingsbescherming", Bbs) and its underlying regulations have come into force. More information on this is available in section E.

Recent developments of the Regulatory Body

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 regulatory body, have largely merged into the one entity, the Authority for Nuclear Safety and Radiation Protection (Dutch acronym: ANVS). On August 1st 2017 the ANVS attained the formal status of an independent administrative body (ZBO). Other governmental entities have some regulatory tasks in radiation protection but the majority of the tasks, including the ones related to safe management of spent fuel and radioactive waste, are fully within the scope of the ANVS. Therefore, this report will often refer to the ANVS as "the regulatory body". More detailed information on the regulatory body can be found in section E.

Cooperation agreement radiation protection

As there are other organisations with responsibilities and tasks in relation to radiation protection on the basis of the Nuclear Energy Act, a Cooperation Agreement for Radiation Protection (signed in 2017) was set up to describe the interaction, communication and cooperation between the ANVS and the concerned policy departments and inspectorates of other ministries. More detailed information can be found in section E.

Advisory Board

The ANVS appointed an Advisory Board (Dutch: Raad van Advies) on 17 April 2018. The board can provide the ANVS with solicited and unsolicited advice on matters related to the tasks of the ANVS. It has six members, with expertise relevant to the tasks of the ANVS. The Advisory Board has issued several advices, among others on the role of the ANVS around disposal of radioactive waste and on knowledge management. For more information, see section E, Article 20.1.

Evaluations of the ANVS

In 2018 and 2019 two evaluations of the ANVS, one internal and one external, were conducted. The evaluations confirm the findings of the 2018 IRRS-Follow Up mission: the ANVS has been functioning well. To further improve the ANVS, two actions were taken:
- Reorganization of the structure of the ANVS. This reorganization was completed by January 1st, 2020.
- Transferring the responsibility for the task 'policy development' to the Ministry of Infrastructure and Water Management. The change came into effect on May 15th 2020. More specifically, this means that the Directorate-general for Environment and International Affairs (DGMI) within the ministry of Infrastructure and Water Management is now responsible for policy development with regard to nuclear safety, security and radiation protection.

More information is available in section E.

Other recent developments
- At the end of 2017, the final report of the national research programme on geological disposal "OPERA" (OnderzoeksProgramma Eindberging Radioactief Afval, English translation: research programme on disposal of radioactive waste, 2011-2017) was published. For more information, see Section B. COVRA is planning to start a continuous research programme on geological disposal in 2020.

- 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 the second National Report which shows how the Netherlands meets the requirements of the articles of this Directive in 2018.

- In November 2018 an IRRS-follow-up mission took place as a follow-up of the November 2014 IRRS-mission. An International Atomic Energy Agency (IAEA) team of experts concluded that the Netherlands has significantly strengthened its regulatory framework for nuclear and radiation safety since 2014 and particularly by establishing a single independent regulatory body[3]. The overall result[4] was that of the 45 recommendations, 26 recommendations and suggestions were fully closed, 18 out were closed by the IRRS review team with confidence that they will be implemented within a reasonable time leaving only one recommendation open. The latter deals with the creation of release radiation levels of a greenfield after dismantling of an installation or finalization of an activity. For more information on the open recommendation, see the update on challenge 4 below; for more information on both IRRS missions, see Annex 5.

3 https://www.iaea.org/newscenter/pressreleases/iaea-mission-says-the-netherlands-has-significantly-strengthened-its-regulatory-framework.

4 Final mission report: https://www.autoriteitnvs.nl/documenten/rapporten/2019/06/06/integrated-regulatory-review-service-irrs.-follow-up-report-to-the-netherlands.

- On four separate occasions in late 2018 and early 2019 (three occasions in the Netherlands and once in Germany) potentially dangerous HASS containing Co-60 were found in scrap metal originating from Africa, purchased on the international scrap metal market. All four events were reported to the IAEA. The radioactive sources were not shielded. Close international collaboration between the IAEA, the Netherlands, Germany and country of shipment, both by the regulatory bodies as well as by the ambassadors, has resulted in an IAEA Fact Finding Mission to the country of shipment. Several points of improvement have been identified. Since the detection on March 7, 2019, no new detections of similar radioactive sources have been reported. For more information, see section J.

- In July 2019 a project started to "advise on a possible societal decision-making process on disposal of radioactive waste and spent fuel using a participative process and advising relevant stakeholders on the results". For more information, see the update on the third challenge in this Section.

- The interim storage facility of COVRA for high-level waste (HABOG) is currently being be extended. For more information, see Section G, Annex 1 and 2.

- At the time of writing this report, there are no indications that the measures taken in the Netherlands to prevent spreading of the COVID-19 virus have had implications on the safety and continuity of the management of radioactive waste and spent fuel.

Update on the challenges and suggestions from the sixth Review Meeting

During the sixth Joint Convention Review Meeting, several challenges facing the Netherlands were identified. They are listed below with an update on their status.

Follow-up challenges

1. Proceeding from storage to disposal including public acceptability

The national programme describes the route the Netherlands is taking towards disposal. After the interim storage period, geological disposal is foreseen around 2130. The decision-making therefore is expected around 2100. 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 planned updates of the national programme (updated at least every ten years, due 2025), the national report on implementation of the national programme as obliged by Council Directive 2011/70/Euratom (every three years, due 2021) as well as policy papers. All of these are available to the public.

Both COVRA as well as ANVS publish information on management of radioactive waste on their websites (www.covra.nl and www.anvs.nl). The information is constantly 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. For more information on reporting and information to the public, see the text on Article 20.

From 2011-2017 research on geological disposal of radioactive waste and spent fuel in Boom Clay has been performed in a national research programme called "OPERA". OPERA resulted in:
- An initial Safety Case for the geological disposal of radioactive waste and spent fuel in Boom Clay[5] [6]. The Safety Case also contains a road map for further research by COVRA. Based on this road map, COVRA is planning to start a continuous research programme on geological disposal in 2020.
- A report[7] of the OPERA Advisory Group, which elaborates on the societal issues of disposal, including stakeholder engagement and conditions for the long-term decision-making process on disposal.
- Refer to Annex 4 for more information on OPERA.

5 Summary of OPERA initial Safety Case: https://zoek.officielebekendmakingen.nl/blg-830955.
6 OPERA initial Safety Case: https://zoek.officielebekendmakingen.nl/blg-830956.
7 Report of OPERA Advisory Group: https://zoek.officielebekendmakingen.nl/blg-830958.

For the period July 2019 till July 2024, the Minister of Infrastructure and Water Management has entrusted the Rathenau Institute to organize a participative process to deliberate on a possible societal decision-making process on disposal of radioactive waste and spent fuel ('participation on participation') in a project called "Toekomst Radioactief Afval" (English translation: "Future of Radioactive Waste"[8]). The results and experiences will be consolidated in an advice to the Minister of Infrastructure and Water Management. For more information, see challenge 3 in this section.

In accordance with the advice from the Advisory Board of the ANVS on the role of the ANVS around disposal (see section E), and the results of the external evaluation of the ANVS, the responsibility for the preparation of the policy on disposal of radioactive waste and spent fuel was transferred from the ANVS to the Ministry of Infrastructure and Water Management in May 2020. This transition enables the ANVS to focus on the safety aspects of the disposal facility, while the Ministry of Infrastructure and Water Management develops the policy around disposal in order to arrive at a publicly accepted disposal facility.

2. 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. Even 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 (LILW) were transported to COVRA. The mixed high-level waste (HLW) 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 containers were 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. In four cases, the corrosion caused degradation of the drums to such a degree that the drums could not be lifted in the usual way. 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 (except the degraded drums and five stored underneath these) that were known or expected to contain PVC (based on archived information), about 130 in total, were sorted, repacked, and prepared for interim storage at COVRA. The PVC was removed from the highly active waste and as much as possible repacked separately. Recently, a special tool has been developed by NRG to recover the degraded waste drums. After finishing the safety analysis and training, it is expected that these last PVC drums will be sorted and repacked before the end of 2021.

As licence holder of the WSF and owner of most of the stored waste, NRG is responsible for transferring the waste to COVRA as soon as reasonably achievable. This is a complex task that NRG fulfils by elaborating plans for treatment, repackaging and transfer of all types of waste. These plans are regularly updated and reviewed by the regulatory body. In 2018, the Dutch authorities performed an investigation on the effectiveness and efficiency of these plans and concluded that the chain of waste management from NRG to COVRA should be optimized and that the project planning and budget was not realistic. A mediator was appointed by the government to boost the cooperation between NRG and COVRA and seek for chain optimization. Furthermore, the government provided extra budget as a loan to NRG to cover the increased costs of the historical waste project.

The cooperation between COVRA and NRG has been intensified between 2018-2020. At the Research Location Petten the sorting and repackaging of the waste has been prioritized. This has resulted in a better integrated, more detailed project planning and a more steadily transfer of waste from Petten to COVRA.

Up to now, more than half of the stored drums has been sorted and repacked. The LLW-fraction that is formed in the process is continuously transferred to COVRA. For the ILW-fractions, plans for the transfer to COVRA are worked out in detail. Furthermore, before the end of 2020 all stored resins from the HFR will be transferred to COVRA. The transfer of the resins to COVRA has become a normal, operational route.

In the most recent plan, approved by the regulatory body in 2019, NRG plans to have all legacy waste from the WSF in Petten removed before the end of 2026. NRG has to submit an updated plan for approval before 1 July 2022.

8 This includes spent fuel.

New Challenges

3. Establishment of Disposal Advisory Platform (**exact role, members, goals, research agenda**)

In the national programme, the establishment of a consultation group on the management of radioactive waste and spent fuel (Disposal Advisory Platform) was announced. During the sixth review meeting of the Joint Convention, the exact role, members, goals and research agenda of this consultation group were still to be defined.

To further define the mission of this consultation group, a number of interviews with national stakeholders (researchers, local and national government, waste producers and NGO's) were conducted. Lessons learned by countries with experience on public participation were also collected during interviews. The main conclusion of this research was that there is support for the establishment of such a consultation group in the Netherlands but stakeholders agreed that this consultation group should have a more active role than solely acting as a sounding board. Therefor instead of establishing one consultation group, it was decided to start a project in which a variety of stakeholders can participate.

From July 2019 till July 2024, the Rathenau Institute will lead this project called "Toekomst Radioactief Afval" (English translation: "Future of Radioactive Waste"[9]). The "Toekomst Radioactief Afval"-project has the following mission: organize a participative process to deliberate on a possible societal decision-making process on disposal of radioactive waste and spent fuel ('participation on participation') and advise relevant stakeholders on the results. The project consists of both the interaction of the dialogue with citizens, stakeholders and experts as well as research activities. The results and experiences will be consolidated in an advice to the Minister of Infrastructure and Water Management.

4. Further development of decommissioning policy

In 2018 the ANVS evaluated the needs and wishes of a decommissioning policy. The identified issues were collected in a 'to-do'-list with an owner and planning.

Practical experience: decommissioning of a research reactor (RR)
The decommissioning of the LFR RR was the first decommission project of a nuclear facility. In practice the decommission of the LFR resulted in a lot of constructive exchanges with the licence holder. This showed that a case-by-case approach is needed for detailing the decommissioning. For the Netherlands, with a small but diverse nuclear sector, case-by-case approaches is considered to be an efficient way. The decommissioning policy will be developed further in connection with the development of clearance levels for terrains and sites and the decommissioning plans for non-nuclear facilities (see below).

Decommissioning plan for non-nuclear facilities
With the national implementation of the Euratom Basic Safety Standard Directive (Council Directive 2013/59/Euratom) in Article 10.8(1) of the Decree on Basic Safety Standards for Radiation Protection, licence holders of designated categories of non-nuclear facilities[10] (e.g. cyclotrons and coal-fired power stations) are obliged to have a decommissioning plan. This decommissioning plan describes the measures that are to be taken when sources of radiation are definitely no longer used. The decommissioning plan must include a financial paragraph.

Guidance for licence holders
In 2020, the ANVS has started to further develop an execution policy regarding the non-nuclear applications of radiation in medicine, research, industry and agriculture. Among others this will include the financial (if applicable) and technical valuation aspects in licence authorisation for the use, decommission and/or removal of radiation sources and (non-nuclear) installations. Part of it is the finalization of guidance for the licence holders. The guidance will be based on the existing national regulation, the IAEA safety standards and guidance (Safety Guide No. SSG-49 Decommissioning of Medical, Industrial and Research Facilities Specific 2019). The guidance is planned to be finalized in in 2021.

9 This includes spent fuel.
10 The designated categories are named in Article 10.1 of the Regulation on Basic Safety Standards for Radiation Protection.

Clearance of land and sites

The last few years investigations on clearance of land and sites continued. Aim of the investigations is to derive practical guidance and possibly regulations from the general concepts that are the basis for the clearance of land and sites (these concepts are for instance described in ICRP-103[11] and IAEA WS-G-5.1[12]). Recent developments are:

- Aiming for a harmonized approach, a study was conducted on international standards and approaches, including the requirement from the Directive 2013/59/Euratom and experiences from selected (European) countries.
- In addition an investigation was started to find common approaches on the clearance of sites and land with regard to chemical pollution.
- Also research was started on how to determine that a certain area of land meets the clearance criteria. This includes the selection of the appropriate measurement methods and what sampling methods are needed.

(Specific) clearance of radioactive materials

For specific circumstances, the Bbs includes the possibility for specific exemption or specific clearance by decision or regulation of the ANVS. Specific clearance levels are set by ANVS regulation for:

- Lamps and lamp starters containing Kr-85;
- Wet sludge from oil and gas production and geothermal application;
- Clearance of liquids by incineration;
- ~120 nuclides in material containing very low levels of activity that pose a very limited risk;
- Emission to air and (surface)water for K-40.

An example of specific clearance by decision, is the specific clearance of several waste streams resulting from the decommissioning of a phosphor producing facility. Under specific conditions, these waste streams can be disposed of in a designated landfill.

Inventory of radioactive waste

A project started to update the national inventory of radioactive waste and spent fuel. In this project the waste streams from production via the waste processors to interim storage at COVRA or disposal at the landfill will be investigated and mapped, including an estimate of the inventory in 2130. One of the aims is to separately map the amounts of waste from decommissioning. This information will give the RB a better insight in the magnitude of the waste streams coming from decommissioning projects. The results of this project will be used as a basis for future policy making on decommissioning and waste minimization (e.g. by using tools as specific clearance).

Recommendation from the IRRS follow-up mission

In the conclusions of the IRRS follow-up mission in November 2018 one of the recommendations given in the 2014 mission remained open: 'The regulatory body should develop requirements on the end state of decommissioning, termination of the authorization for decommissioning and on the release of the facility and/or the site from regulatory control.' In order to close the recommendation, research has started on an assessment framework on radiological release criteria for release of a site after dismantling of an installation or finalization of an activity. A preliminary study on criteria for release of a facility or site from regulatory control has been performed. For more information on the IRRS-missions, see Annex 5.

Overarching issues from the sixth review meeting

During the sixth Review Meeting, the Contracting Parties agreed that National Reports for the next Review Meeting should address, as appropriate, the actual measures that have been taken in implementing the following issues[13]:

[11] ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4).

[12] IAEA, 2006, Release of Sites from Regulatory Control on Termination of Practices.

[13] Final summary report, June 2018.

1. Implementation of national strategies for spent fuel and radioactive waste management

The Netherlands has one central facility for interim storage of all radioactive waste and spent fuel (COVRA) to which all waste producers must transfer their radioactive waste as soon as reasonably possible. This implies that storage of radioactive waste and spent fuel at the location of the waste producer is limited. Also the legacy waste in Petten is being transferred to COVRA. For more information on the policy on waste management, see Section B and for more information on legacy waste, see the text at Article 12(ii).

COVRA has various dedicated buildings for the different waste streams. For more information on (graded approach of) the interim storage of radioactive waste at COVRA, see Annex 1. In the waste management of NORM-waste, the graded approach is implemented by allowing NORM-waste between 1 – 10 times the general clearance levels, or when specific clearance is applicable, to be disposed of at designated landfills. For more information on NORM-waste, see section B.

After the period of interim storage, geological disposal of all radioactive waste stored at COVRA is foreseen in 2130 in one disposal facility. For more information on the planning of the disposal facility, see aforementioned developments and, in more detail, section B.

Minimising the occurrence of radioactive waste is one of the policy principles. Prevention of waste production, reuse and using radioactive decay are instruments for minimising the volume and activity of radioactive waste in the Netherlands. For more information on the implementation of the policy principle on minimisation and the other policy principles, see section B.

The Dutch classification of radioactive waste and spent fuel is based on practical criteria both derived from the need to limit exposures during the long-term interim storage period and from requirements set by the disposal route. Roughly speaking, the IAEA categories high-level waste and intermediate-level waste equate broadly with the Dutch category high-level waste and the IAEA categories low-level waste and very low-level waste with the Dutch category low- and intermediate-level waste. For more information on the classification of radioactive waste and the link with the IAEA classification, see the text on Article 32.1(v) and Section D.

2. Safety implications of long-term management of spent fuel

Government policy on reprocessing of spent fuel leaves the choice of whether or not to reprocess to the operator of the nuclear power plant. COVRA has waste acceptance criteria for direct storage of RR spent fuel as well as waste acceptance criteria for reprocessed NPP spent fuel. For more information about the policy on reprocessing and the current practice, see Section B.

During the sixth Review Meeting, the Country Group identified the upfront design of packages and facilities for long-term safe interim storage (100 –300 years) as an Area of Good Performance for the Netherlands. Together with the safe management of the spent fuel at a centralized facility and the inspection programme of the ANVS, the safety of the long-term management of spent fuel is guaranteed.

Some advantages of having a long-term interim storage in buildings are mentioned in the text at Article 32.1(iii).

In the national research programme on geological disposal (OPERA, 2011-2017) an initial Safety Case for the geological disposal of radioactive waste and spent fuel in Boom Clay, has been developed. The Safety Case also contains a road map for further research. Based on this road map, COVRA is planning to start a continuous research programme on geological disposal in 2020. Refer to Annex 4 for more information on OPERA.

3. Linking long-term management and disposal of disused sealed radioactive sources

When return to the supplier or reuse of a sealed radioactive source is not possible, the disused sealed radioactive source will be stored at COVRA. After the period of interim storage, geological disposal of all radioactive waste stored at COVRA in one facility is foreseen in 2130. For more information, see section J.

4. Remediation of legacy sites and facilities

The Netherlands does not have any legacy sites or facilities, meaning that all radioactive waste is owned by a licence holder. In Petten, there is still some waste that has to be transferred to COVRA. For more information, see challenge 3 in this section and the text on Article 12(ii).

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 below.

Type of liability	Long-term management (LTM) policy	Funding of liabilities	Current practices / facilities	Planned facilities
Spent fuel (SF)	It is up to the licencee to decide if SF is to be reprocessed. RR-SF and HLW resulting from reprocessing of SF of NPP Borssele, are to be stored at COVRA, the national WMO. Licencees pay all-in tariffs that are determined by COVRA and which cover all costs of storage and disposal of SF and radioactive waste (RW). It is foreseen that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological disposal facility.	If applicable, SF producers fund the reprocessing of SF and management of resulting wastes. Via tariffs, licence holders fund storage and disposal of their SF and RW. Upon transferal of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA.	SF of NPP Borssele is reprocessed in France; resulting vitrified and metallic HLW are stored in HABOG[14] at COVRA. SF of RRs is stored in HABOG at COVRA. The main producers of nuclear waste generally directly pay for the construction costs of the buildings in which the waste is stored, these construction costs are not included in the waste management tariffs.	A geological disposal facility is foreseen 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 COVRA. Licencees pay all-in tariffs that are determined by COVRA and which cover all expected costs of storage and disposal of RW. It is foreseen that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological disposal facility.	Via the tariffs of COVRA, licence holders fund storage and disposal of their radioactive wastes. Upon transferal of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA.	All NFC waste is transferred from licence holders to COVRA followed by storage in aboveground facilities at COVRA. The main producers of nuclear waste generally directly pay for the construction costs of the buildings in which the waste is stored, these construction costs are not included in the waste management tariffs.	A geological disposal facility is foreseen around 2130.
Application wastes	All radioactive wastes have to be stored at COVRA. Licencees pay all-in tariffs that are determined by COVRA and which cover all expected costs of storage and disposal of RW. It is foreseen that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological disposal facility.	Via the tariffs of COVRA, licence holders fund storage and disposal of their radioactive wastes. Upon transferal of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA.	All radioactive waste is transferred from licence holders to COVRA followed by storage in aboveground facilities.	A geological disposal facility is foreseen around 2130.

[14] HABOG: the high-level waste treatment and storage building.

Type of liability	Long-term management (LTM) policy	Funding of liabilities	Current practices / facilities	Planned facilities
NORM- waste	Disposal of NORM-waste between 1 – 10 times the general clearance levels at designated landfills. When specific clearance is applicable: disposal of NORM-waste below the specific clearance levels at designated landfills. For NORM-waste with an activity concentration > 10 times the general clearance levels and when specific clearance is not applicable: see application wastes.	Via tariffs, waste producers fund disposal of their radioactive wastes at designated landfills.	Disposal of NORM-waste between 1 – 10 times the general clearance levels at designated landfills. When specific clearance is applicable: disposal of NORM-waste below the specific clearance levels at designated landfills.	No planned facilities.
Decommissioning Liabilities	Since 2011 it is mandatory for licence holders 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 licence holder of a nuclear facility to have and periodically (every five years) update a decommissioning plan during the lifetime of the facility or sooner when there is a need to update the decommissioning plan. The ANVS will evaluate the plan and decide on approval. Ultimate responsibility rests with the licence holder.	The licence holders of nuclear reactors are required to have financial assurance for decommissioning, to cover the costs of decommissioning (including a contingency add-on) and resulting waste management costs. The financial assurance will have to be updated and approved by the authorities at least every 5 years or sooner when there is a need to update the decommissioning plan or the financial assurance. The Ministers of Finance and of Infrastructure and Water Management are responsible for the evaluation and approval of the financial assurance for decommissioning.	Licence holders of NFC facilities are required to have an up-to-date decommissioning plan throughout their entire lifecycle. Licence holders of nuclear reactors are required to have also an updated FG.	A NPP is in Safe Enclosure (Dodewaard).
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. Licencees pay all-in tariffs that are determined by COVRA and which cover all expected costs of storage and disposal of RW. It is foreseen that all radioactive wastes, including HLW from reprocessing and RR-SF, ultimately will be disposed of in one single geological disposal facility.	HASS (High Active Sealed Sources) are regulated according to EU regulations15, 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 foreseen around 2130.

[15] 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 Reporting

Summary of the policy on management of spent fuel and radioactive waste

The various elements of the policy apply to both management of radioactive waste as well as spent fuel.

An important aspect of the policy on management of spent fuel and radioactive waste is that radioactive waste and spent fuel should be transferred as soon as reasonably possible to COVRA for long-term centralized interim storage in dedicated buildings followed by geological disposal in 2130[16]. The definitive decision on the disposal method will be taken around 2100.

This policy is based on the following principles:
- Minimising the occurrence of radioactive waste, both in volume as activity. Prevention of waste production, reuse and using radioactive decay are successful policy instruments.
- Safe management of radioactive waste now and in the future. During interim storage at COVRA, the waste is safely managed. Around 2130 geological disposal is foreseen. The design of the geological disposal facility shall allow the retrieval of the waste (via the existing shaft) during the use of the geological disposal facility.
- No unreasonable burdens on the shoulders of future generations. Generations that have profited from a specific application of radioactivity, such as nuclear power or medical isotopes, must bear the burdens for managing the waste produced in those activities.
- Those who produce radioactive waste bear the costs for the management of the waste. For all costs involved in the management of the radioactive waste the 'polluter pays' principle applies.

For more information on the policy on management of spent fuel and radioactive waste, see Article 32.1 (i) and (iii).

[16] The period till 2130 will be used to collect enough radioactive waste and in addition enough money for the disposal. Directed by the principle 'the polluter pays', and with the use of a capital growth fund, around 2130 sufficient financial resources are created to fund the disposal.

32.1 (i) Spent fuel management policy

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

Reprocessing
The policy in the Netherlands on spent fuel management is the following: the decision on whether or not to reprocess spent fuel is, at first, taken by the operator of a nuclear facility. 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 will evaluate the 'back-end' strategy 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 on-site temporary storage of spent fuel in the spent fuel pool to reduce residual heat before shipping to France for reprocessing. The actual length of the cooling period is according to the safety requirements of the transport packages and the specifications of the reprocessing company (namely Orano). The operator of the Borssele NPP decided in favour of reprocessing spent fuel for both economic reasons, reuse of plutonium and reduction of the volume of waste. According to the current contract, the spent fuel is transferred after the cooling period to Orano's facilities in La Hague (France) for reprocessing. The fuel pool inventory is kept to a practical minimum, as required by the plant's operating licence.

In July 2006 a new French legislation entered into force, prescribing a formal agreement beforehand of the returnscheme for the radioactive waste after the reprocessing of the spent fuel (i.e. before the spent fuel is sent to France). In 2009 a bilateral agreement[17] between France and the Netherlands was signed for Dutch spent fuel produced until 2015. A new agreement[18] entered into force on 1 January 2014, regulating matters related to Dutch spent fuel produced after 2015. This includes its acceptance by Orano in France, its reprocessing, and the return of radioactive wastes to the Netherlands - before 31 December 2052. After reprocessing, the vitrified waste and the residual waste components are sent back to the Netherlands for interim storage in the HABOG-facility at COVRA.

Under previous contracts all the plutonium extracted from the Borssele NPP reprocessed spent fuel was sold for reuse in MOX fuel for NPP's. Reprocessed uranium is also reused in fresh fuel. The plutonium made available under the current contract will also be reused in MOX fuel. A licence for NPP Borssele to use MOX elements was issued in June 2011, and the first MOX elements were loaded in 2014.

Dodewaard NPP
All spent fuel from the Dodewaard NPP was removed from the site in 2003. The spent fuel 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 vitrified waste was returned from Sellafield to the Netherlands in March 2010, and shipped to COVRA for interim storage.

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17 Agreement between the Government of the Kingdom of the Netherlands and the Government of the French Republic concerning amendment to the Agreement of 29 May 1979 concerning the reprocessing in France of irradiated fuel elements, Paris, 2 September 2009.

18 Agreement between the Government of the Kingdom of the Netherlands and the Government of the French Republic concerning the reprocessing in France of Dutch irradiated fuel elements, The Hague, 20 April 2012.

Spent fuel from the research reactors

Spent fuel from research reactors is not being reprocessed. After storage in the on-site spent fuel pools, the spent fuel elements are directly transported to COVRA for interim storage. A cooling period of at least three years is applied before the spent fuel 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.

HFR

Following the international non-proliferation effort initiated by the USA[19] in 1978 to substitute Low Enriched Uranium (LEU) to High Enriched Uranium (HEU), the HFR in Petten completed its conversion to LEU targets in May 2006. The last HEU fuel elements from the HFR were transported to COVRA in March 2011.

LFR

The consumption of fuel in the LFR in Petten was very low. The original fuel elements were still in use until the permanent shut-down of the reactor in 2010. All spent fuel has been transferred to COVRA in December 2013.

HOR

At the HOR in Delft the conversion from HEU fuel to LEU fuel 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

The various elements of the policy apply to radioactive waste as well as to spent fuel.

National policy

National programme for the management of radioactive waste and spent fuel

The current policy on the safe management of spent fuel and radioactive waste has been detailed in the 'national programme for the management of radioactive waste and spent fuel'[20], 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 spent fuel and radioactive waste and it also includes other related issues like an inventory and a description of the route to disposal. The national programme is updated at least every ten years, in accordance with Directive 2011/70/Euratom.
The national policy on the management of spent fuel 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.

The policy on radioactive waste is connected to 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.

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19 IAEA: Management of high enriched uranium for peaceful purposes: status and trends: https://www-pub.iaea.org/MTCD/Publications/PDF/te_1452_web.pdf, 2005.
20 www.anvs.nl.

The policy allows for the use of 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 is in compliance with the policy for conventional waste. 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: prevention, reuse and finally, safe management of remaining waste substances.
Furthermore, as with management of conventional waste, the IBC-principle[21] is applied to the management of radioactive waste: isolate, manage and control.

Centralized long-term interim storage
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 centralized interim storage of the radioactive waste and spent fuel at COVRA for a period of at least 100 years. This is the stage of long-term interim 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 interim storage period. It is foreseen that the disposal facility will be ready to receive radioactive wastes around 2130. The design of the disposal facility must allow for the possibility of retrieval of the waste (via the existing shaft) during the operation of the disposal facility. The definitive decision on disposal will be made around 2100. Up to that moment, society may also opt for another management option, depending on available insights and technologies.

Some advantages of having a long-term interim storage in buildings are:
- The volume of radioactive waste that has to be disposed of can grow as a result of which operating costs per unit of waste could be restricted. In addition, new technical advances could take place into the most efficient and cheapest method possible of disposing the waste. The period of 100 years can also be used for allowing money placed in a fund to accumulate;
- 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 surface disposal facility;
- Heat generating waste will cool to a temperature at which it is easier to handle and to dispose of;
- Since no choice has yet been made for a location for the disposal facility, this period can be used to make a selection of a suitable location in consultation with society;
- There is time to learn from the experiences in building and operating geological disposal in other countries;
- There is time for research into the best long-term solution and new techniques; other management options may become available;
- During the long-term interim storage period, international or regional solutions may become available. Disposal, certainly for a country with a small nuclear sector, is the most costly step in the management of radioactive waste. Cooperation between countries on radioactive waste management can result in cost savings.

Long-term interim storage poses challenges such as maintaining knowledge and public participation (see Section K for more information). It also forces to construct safe and robust storage buildings. During the sixth Review Meeting, the upfront design of packages and facilities for long-term safe interim storage (100 –300 years) was identified as an Area of Good Performance for the Netherlands. Disposal should be kept on the agenda in order to take steps forward.

Decay storage
There are forms of radioactive waste that require several tens of (thousands of) years to decay below the threshold values. According to regulations, such wastes shall be stored at COVRA followed by disposal. However, the Government aims at 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 maximum period of 50 years. After decay below clearance levels, the material can be reused.

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

One geological disposal facility

All types of radioactive waste at COVRA will be disposed in one geological disposal facility. The cumulative waste volume that is currently in interim storage at COVRA in the Netherlands, is several tens of thousands cubic meters. In volume almost all is LILW (see inventory in Section C, Article 32.2 (iv)). Note that there are designated landfills for specific cases of NORM waste (see the text on Article 32.1 (iv)).

Retrievability

For several decades, retrievability has been included as a precondition in the policy for the management of radioactive waste in a disposal facility. This means that the possibility for retrieving waste (packages) must be included in the design of a facility, such that the retrievability of the waste (via the existing shaft) must be possible during the use of the disposal facility. Research in the past has shown that it is possible to create a retrievable geological disposal facility in clay and salt, for a period of one hundred through to several hundreds of years. Following this period, the radioactive waste can still be retrieved via a new shaft.

Dual strategy

To 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 seven 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 investigated of establishing an European waste management organisation that would implement one or more shared geological repositories in Europe. For more information on international collaborations by the Netherlands, see Annex 3.

Public Participation

Transparency of nuclear activities and close communication to the public aid to enable a dialogue among stakeholders and the public debate on disposal, at the same time yielding confidence in the regulator and in the safety of radioactive waste management. There are several regulations that describe the role the general public plays and the participation in various procedures (see Section E, Article 19 for more information).
As mentioned in Section A (challenge 3 from the last Review Meeting), the ongoing project "Toekomst Radioactief Afval" (English translation: "Future of Radioactive Waste" [22]) at the Rathenau Institute consists of both the interaction of the dialogue with citizens, stakeholders and experts as well as research activities and is in fact a public participation process on public participation.

Research programme

The Netherlands is involved in research on the long-term management of spent fuel and radioactive waste for decades already. Results from the research programmes have been used as input for the policy development on the management of spent fuel and radioactive waste. In the Netherlands, a few institutes have several decades of experience with research into geological disposal and drafting of safety cases. Notable institutes, which have been involved in most of the past and present national research programmes regarding radioactive waste and spent fuel disposal, are the TNO institute's geosciences branch and the Nuclear Research & consultancy Group (NRG).

The latest national research programme on geological disposal is called OPERA (OnderzoeksProgramma Eindberging Radioactief Afval, English translation: research programme disposal radioactive waste, 2011-2017). COVRA has been asked to coordinate this 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.
In OPERA, an initial Safety Case, the first in a series of Safety Cases, for the geological disposal of radioactive waste and spent fuel in Boom Clay has been developed. The initial Safety Case gives good indications that a stable and robust disposal of all current and expected Dutch radioactive waste at 500 meters depth in Boom Clay may be possible in the

[22] This includes spent fuel.

Netherlands, although several uncertainties remain and should be clarified in the following Safety Cases. The Safety Case also contains a road map for future research. A separate, complementary report of the OPERA Advisory Group deals with the societal issues of geological disposal, including stakeholder engagement and conditions for the long-term decision-making process on disposal.

OPERA focussed on the Boom Clay, still salt formations and other clay formations are also viable options for geological disposal. Salt as host formation has been explored in the past in the Netherlands and a limited update study has been carried out in OPERA. Much of the information and many of the approaches developed in OPERA are directly transferrable for an evaluation of these other formations (e.g., work on waste types, inventories, packaging, overlying geological formations and safety assessment modelling).

Based on the OPERA road map for future research, COVRA is planning to start a continuous research programme on geological disposal in 2020.

For more information about the research programmes, see Annex 4.

32.1 (iv) Radioactive waste management practices

Overview

Table 1[23] below 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

Category radioactive waste	Interim management	Long-term management
HLW	Storage at COVRA	
LILW	Storage at COVRA	Geological disposal[24]
NORM, subject to licensing	Storage at COVRA	
NORM, subject to notification (i.e.: up to 10x the general clearance level)	-	Designated landfill
Radioactive waste with $T_{1/2}$ < 100 days decaying below clearance levels in 2 years	-	
Radioactive waste decaying below clearance levels in 50 years	Storage at COVRA	Reuse or reprocessing as conventional waste
Radioactive waste below clearance levels	-	
When applicable: radioactive waste between general and specific clearance levels	As specified in the requirements for the specific clearance	As specified in the requirements for the specific clearance

Storage facilities

One national central interim storage facility: COVRA in Nieuwdorp

The national waste management organisation, Central Organisation For Radioactive Waste (COVRA), was established in 1982 at the initiative of the Dutch government. COVRA was temporarily based in Petten and relocated to Nieuwdorp at the end of the 1980's.

The nuclear programme of the Netherlands is relatively small, but diverse. The total quantities of spent fuel and radioactive waste are modest. Nuclear installations do not have their own (long-term) waste storage facilities. Radioactive waste must be transported to COVRA as soon as reasonably possible. Benefits of economies of scale are

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

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

optimized by centralizing most of the radioactive waste management activities in the Netherlands in one national WMO (COVRA), and on one site.

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 on the production site;
- Large amounts of NORM-waste is reused or disposed of at (designated) landfills (for more information, see the section on NORM at this Article);
- Some legacy waste is still present at the research location Petten. For more information, see the section on Article 12(ii)).

The COVRA site is approximately 25 hectares, dimensioned to handle the expected Dutch demand for interim storage capacity until at least the year 2130. On the COVRA site there are various waste processing facilities and storage facilities for radioactive waste and spent fuel. The storage facilities have been designed to last at least for one hundred years, however if needed they can be refurbished or replaced to accommodate a longer interim storage period. COVRA includes all estimated costs for processing, storage and disposal in its charges, on the basis of the state of the art at that time. Moreover, with the implementation of Directive 2011/70/Euratom, the obligation has been introduced to set off COVRA's research costs for disposal in the charges imposed by COVRA. The final goal is to acquire the financial resources and knowledge needed to achieve disposal around 2130. The accumulated funds are projected to grow during the period of interim storage in order to cover the cost for both long-term interim storage and for the implementation and operation of the (geological) disposal facility for the waste as well as associated research.

After delivery of the radioactive waste, the legal ownership of the waste and the related (financial) liabilities are transferred to COVRA. The fact that COVRA takes full responsibilities for the waste is laid down in the General Conditions of COVRA. The waste producer receives a proof of the transfer of its radioactive waste to COVRA.

Since 2002, 100% of the shares in COVRA are held by the State and this aids to guarantee a system of long-term institutional control. For more information on the facilities of COVRA, see Annex 1.

Waste Storage Facility (WSF) in Petten

Originally the Dutch radioactive waste storage facility was located at the Research Location in Petten (1985 – 1992). This explains why a certain amount of 'legacy' radioactive waste is still stored in the Waste Storage Facility (WSF) at that location. This waste results from four decades of nuclear research at that location and includes fuel material residues (spent uranium targets and irradiated fuel) and fission and activation products. During the 1990s, most drums containing low- and intermediate-level waste were transported to COVRA. The mixed waste, including high-level waste, that could not be transported directly without treatment and repacking, remained in Petten. Refer to challenge 2 in Section A for more information on this project. It is intended that all legacy waste from the WSF at Petten will have been removed before the end of 2026. NRG is not allowed to store new waste in the WSF. For more information, see the section on Article 12(ii).

Disposal facilities

Landfills

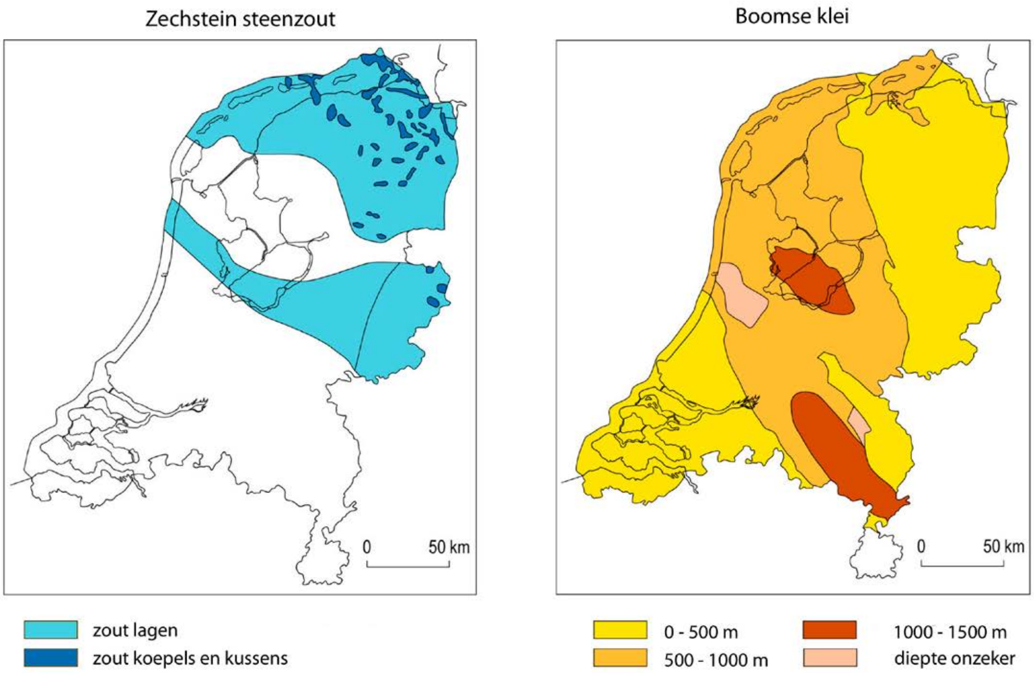
There are two designated landfills for specific cases of NORM waste (see the text on Article 32.1 (iv)) in the Netherlands. These landfills are constructed such that they can safely store these waste streams and they have a licence to do so.

Geological disposal facilities

At the moment there are no geological disposal facilities in the Netherlands, nor are there Underground Research Laboratories (URLs). For research purposes, foreign URLs are used when necessary.

The geological conditions in the Netherlands are at first glance favourable for the geological disposal of radioactive waste. In the northern part of the country there are deep lying, large salt formations. 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 2).

Figure 2: Distribution of Zechstein salt formation (left) and distribution and depth of the Boom Clay formation (right)



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

Sources of spent fuel and radioactive waste in the Netherlands

The spent fuel and radioactive waste are generated by various licence holders which can be divided into six sectors: nuclear, industry, medical, NORM[25] industry, research and miscellaneous.

NORM-waste: waste containing Naturally Occurring Radioactive Materials
Waste containing Naturally Occurring Radioactive Materials (NORM) can result from processing ores and other raw materials. NORM will be considered as radioactive waste, if no further commercial use is foreseen.

Sometimes NORM has natural radioactivity concentrations in excess of the clearance levels. These levels have been specified in the Decree on Basic Safety Standards Radiation Protection (Bbs). Below the clearance levels, no notification to the authorities is required 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 clearance 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 or environment. Mixing up NORM with the sole purpose of dilution is not allowed.

In case no commercial use is foreseen and NORM is declared as waste, and the activity concentration levels are less than ten times the general clearance levels, it can be disposed of at designated landfills. Disposal at designated landfills is also allowed for NORM-waste where specific clearance is applicable and the activity concentration is below the specific clearance levels. These landfills are constructed such that they can safely store these waste streams and they have a licence to do so.

25 NORM, Naturally Occurring Radioactive Material.

NORM-waste shall be transferred to COVRA when no commercial use is foreseen and the general clearance levels are exceeded by a factor of ten. When specific clearance is applicable, but the specific clearance levels are exceeded, the NORM-waste shall also be transferred to COVRA. For instance, waste issued from the 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 the general clearance levels within 100 to 150 years. So, after such a foreseen interim storage period at COVRA as radioactive waste, the material can be disposed of as conventional waste. The waste is stored at COVRA in large freight containers in a modular building (COG[26]) specifically built for this purpose.

Depleted uranium

The tails that remain after the uranium enrichment process at Urenco 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 (U_3O_8) in France and stored at COVRA. The uranium oxide is stored in standardized 3.5 m^3 containers (DV-70, each containing around 12 metric tons of U_3O_8) in a custom-built modular storage building (VOG[27]). 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 was completed. In 2017 a second depleted uranium storage building (VOG-2) became operational. VOG-2 has three storage modules, each module having the capacity to store 2,193 containers.

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 or cloth, plastic, metal- or glass objects. 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 Ni-63, Cs-137, H-3 and Fe-55.

COVRA has dedicated storage buildings for the storage of LILW (LOG[28]).

A substantial volume of LILW waste will decay to a non-radioactive level during the interim 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 evaluated. In the Netherlands, the clearance levels are numerically equivalent to the clearance levels.

HLW: High-level Waste

The HLW at COVRA consists of:
- Heat-generating waste like vitrified waste from reprocessed spent fuel from the NPP's 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 interim storage period, the design of the high-level waste treatment and storage building (HABOG[29]) 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 the well is cooled by natural convection (see Figure 10 and 11). 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 as well as the building is such that these accidents do not cause radiological damage to the environment.

HLW, heat-generating, and HLW, non-heat-generating, are stored in separate compartments of the HABOG. 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.

[26] COG: Dutch acronym 'Container Opslag Gebouw', English translation: container storage building.
[27] VOG: Dutch acronym 'Verarmd uranium Opslag Gebouw', English translation: depleted uranium storage building.
[28] LOG: Dutch acronym 'Laag- en middelradioactief afval Opslag Gebouw', English translation: low- and intermediate-level radioactive waste storage building.
[29] HABOG: Dutch acronym 'Hoogradioactief AfvalBehandelings- en Opslag Gebouw'.

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 and completion is expected in 2021.

The spent fuel 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. For more information on the storage buildings at COVRA, see Annex 1.

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

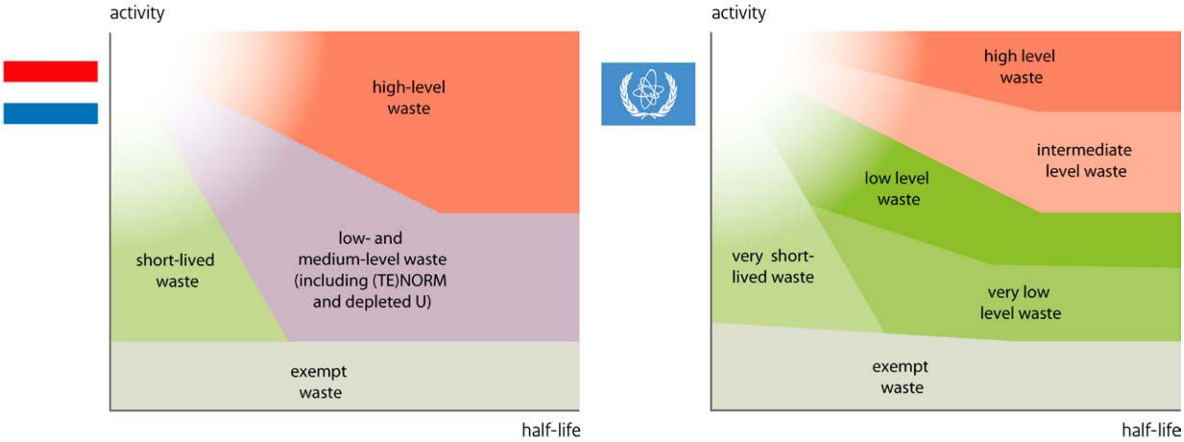
The definition of radioactive waste is given in the Decree on Basic Safety Standards for Radiation Protection, the so-called Bbs[30]: *"A radioactive substance can be designated as radioactive waste by the Authority[31], or the commercial operator, if no product or material reuse is planned for the material either by the Authority or by the commercial operator, and there is no question of dumping the material".*

As stated before, radioactive waste with activity of at least 10 times the clearance levels is collected and managed by COVRA. Long-term interim storage of all radioactive waste in buildings preceding geological disposal in one disposal facility, has been chosen as the preferred national policy.

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 (see Figure 3).

30 Dutch: Besluit basisveiligheidsnormen stralingsbescherming, Bbs.
31 Authority: Authority for Nuclear Safety and Radiation Protection.

Figure 3: The correlation between the IAEA and Dutch classifications of radioactive waste



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

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 research reactors 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.

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 Borssele 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 or in the cooling down phase before being transported back to the Netherlands.

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 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 (NORM-waste).

3.3 *Military or defence programmes*

The Netherlands has decided that waste originating from military or defence 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 (below), 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	Dry storage in vaults at COVRA.	COVRA facility for treatment and storage of HLW and SF (HABOG).
Borssele	Fuel storage pool at Borssele NPP.	Pool belongs to NPP where SF is stored temporarily before shipment to France for reprocessing.
Petten	Fuel storage pool of RR HFR.	Pool belongs to RR where SF is stored temporarily before shipment to COVRA
Petten	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[32].
Delft	Fuel storage pool of RR HOR.	Pool belongs to RR where SF is stored temporarily awaiting shipment to COVRA.

32 More details can be found in section 12(ii).

32.2 (ii) Inventory of spent fuel

The inventory of spent fuel at 31st December 2019, stored at the COVRA facilities, is summarized below:

SF of NPPs[33]	0 m³	0 Bq
SF of RRs	8.0 m³	131.3 PBq
Uranium targets	1.6 m³	3.7 PBq

32.2 (iii) Radioactive waste management facilities

In Table 4 (below), a list of the radioactive waste management facilities is given. Small-scale waste management departments of hospitals, research institutes or industries storing radioactive waste for decay or performing simple operations (such as compacting waste awaiting collection by COVRA) are not included in the list.
Waste storage departments of the Borssele NPP and of the research reactors are not specifically mentioned either, because a general licence condition obliges licence holders to limit their inventories by transferring their radioactive waste periodically to COVRA. NRG is not allowed to store new waste in the WSF.

Table 4 Radioactive waste management facilities

Location	Radioactive waste storage facility	Features
Nieuwdorp	Dry storage of HLW in canisters.	COVRA facility for treatment and storage of HLW and SF (HABOG).
Nieuwdorp	Dry storage of LILW in conditioned form in drums and containers.	COVRA facilities for treatment and storage of LILW (AVG and LOG).
Nieuwdorp	Dry storage of NORM- waste in containers.	COVRA container storage facility (COG) for material in unconditioned form.
Nieuwdorp	Dry storage of depleted uranium oxide in small containers.	COVRA facility for storage of depleted uranium oxide as U_3O_8 in unconditioned form to allow for potential future reuse (VOG and VOG-2).
Petten	Dry storage of unconditioned waste in drums at the WSF.	Partly HLW from irradiation experiments. To be transferred to COVRA[34].
Assendelft & Rotterdam	Disposal of NORM-waste between 1 – 10 times clearance levels[35].	Designated landfills.

33 All NPP SF is reprocessed.
34 More details can be found in section 12(ii).
35 And NORM-waste below the specific clearance levels.

32.2 (iv) Inventory of radioactive waste at COVRA

The inventory of radioactive waste at 31st December 2019, stored at the COVRA facilities, is summarized below:

HLW (excluding SF)	100.2 m^3	2.895 PBq
LILW	11,962 m^3	4,807 TBq
NORM-wastes	22,985 m^3	690 TBq

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

In Table 5 (below) 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	Decommissioned.

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 section on 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 Legislative and regulatory framework

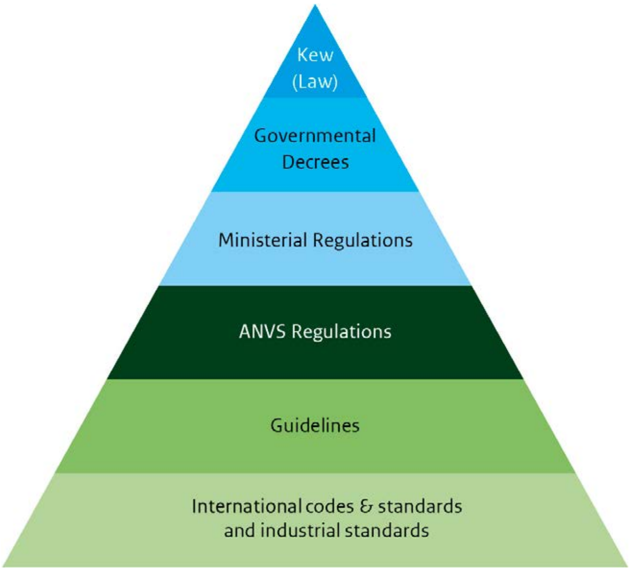
19.1 *Legislative and regulatory framework governing the safety of spent fuel and radioactive waste management*

19.1.a. Overview of national legislative framework

Structure

The legal framework in the Netherlands with respect to nuclear installations can be presented as a hierarchical structure (see Figure 4).

Figure 4: Hierarchy of the legal framework



The Nuclear Energy Act (Kew) is the most prominent law (section 19.1.b).

Governmental Decrees contain additional regulation (section 19.2(i)).

Ministerial Decrees contain additional regulation (section 19.2(i)).

ANVS Regulations give additional rules for certain topics.

Guidelines are safety requirements referenced in the licence of the NPP (section 19.2(i)).

Various industrial codes and standards are part of the licensing base (section 19.2(i)).

In addition to the levels shown in this figure, there are international conventions and other legal instruments related to nuclear safety that also apply. For more information, see section 19.1.c.

The ANVS is authorized to issue 'ANVS – Regulations'. These are issued if:
- Rules are needed on technical or organisational issues.
- Governmental Decrees or Ministerial Decrees refer to guidance to be provided in ANVS Regulation.
- Rules are needed, relevant to nuclear safety, radiation protection and security.

In the hierarchy of the legal framework the ANVS Regulations are positioned between the Regulations like Ministerial Decrees and the NVR's.

Governmental framework

The Netherlands is a parliamentary democracy. On behalf of the Dutch people, Parliament oversees the Dutch government and approves laws and can propose law making to the government. The parliament of the Netherlands, called the States General, consists of two chambers: the House of Representatives (in Dutch: 'Tweede Kamer der Staten-Generaal') and the Senate ('Eerste Kamer der Staten-Generaal'). General elections for the House of Representatives are held at least every four years. The government comprises the King, the Prime Minister, and the other ministers. The Cabinet is the government, excluding the King, but including the State Secretaries. The Cabinet formulates and is accountable for the government's policies.

Process of establishing arrangements such as laws and other requirements
The Constitution of the Netherlands describes how laws are established, and how the Constitution itself can be amended. The national legal framework consists of laws, Governmental Decrees and Ministerial Decrees. The majority of laws are introduced to the Parliament by the Government. The members of Parliament can adopt, reject or amend a Bill. Certain laws, such as the Nuclear Energy Act (Kew), are a so-called 'framework act' whereby the establishment of the underlying detailed requirements is delegated to the Government, ministers or specific administrative bodies.

The Advisory Division of the Council of State[36] provides the Government with independent advice on proposals for new laws and Governmental Decrees. During the procedure of legislation and regulation, the competent regulatory authority involves the relevant actors such as licence holders, non-governmental organisations (NGOs) and public in this process.

There is also a procedure employed for draft Governmental Decrees whereby Parliament is offered an opportunity to examine these closely and suggest improvements. It is up to the responsible Minister to decide how to use this input. Governmental Decrees do not require a vote in Parliament. Ministerial regulations are issued by a Minister. These regulations also are not submitted to Parliament for input or vote.

Ministry of IandWM – Directorate-general for the Environment and International Affairs
The Minister of Infrastructure and Water Management (IandWM) is accountable for nuclear safety, security and radiation protection. This responsibility is delegated to the Directorate-general for Environment and International Affairs (dgMI). The dgMI is therefore responsible for policy development with regard to nuclear safety, security and radiation protection and for the relevant national legislation, i.e. Nuclear Energy Act, and ministerial decrees and regulations.

Regulatory body
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, and thereby regulating nuclear safety, security and safeguards, radiation protection, radioactive waste management and transport safety. The regulatory tasks related to the management of radioactive waste and spent fuel are in the scope of the ANVS. As stated before, since 15 May 2020 policy development and legislation concerning radioactive waste and spent fuel is transferred to the Ministry of Infrastructure and Water Management, i.c. the dgMI.

Several other ministers also have responsibilities in specific areas related to the use of radioactivity and radiation. Therefore some departments of ministries or inspectorates thereof can be considered to be part of the RB under the Nuclear Energy Act.

For more information on the RB, see the section on Article 20.

19.1.b Primary legislative framework: laws

The following are the main laws to which nuclear facilities in the Netherlands, including COVRA[37], are subject:
- The Nuclear Energy Act ('Kernenergiewet', Kew);
- The Environmental Protection Act ('Wet milieubeheer', Wm);
- The General Administrative Act ('Algemene wet bestuursrecht', Awb);
- The Water Act ('Waterwet, Ww);
- Environmental permitting (general provisions) Act ('Wet algemene bepalingen omgevingsrecht', Wabo).

[36] The 'Raad van State', the 'Council of State' has two primary tasks, carried out by two separate divisions. The Advisory Division, as its name implies, advises the government and Parliament on legislation and governance, while the Administrative Jurisdiction Division is the country's highest general administrative court. The basis for these responsibilities can be found in articles 73 and 75 of the Dutch Constitution.
[37] Disposal facilities would also fall in this category. However, there are currently no such facilities in the Netherlands.

Other important Acts with relevance for the licencing and operation of nuclear installations are the Act on Government Information (‘Wet openbaarheid van bestuur’, Wob) and the Dutch Safety Regions Act (Wet veiligheidsregio’s). In this section, the main elements of several acts are elaborated. For more information on secondary legislation, like the aforementioned Decrees and NVR’s, see section 19.2(i).

Nuclear Energy Act (Kew)

The basic legislation governing nuclear activities is contained in the Nuclear Energy Act (Dutch: Kernenergiewet, Kew). It is a framework law, which sets out 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.

With regard to nuclear facilities, the purpose of the Nuclear Energy Act, according to its Section 15b, is to serve the following interests:
- the protection of people, animals, plants and property;
- the security of the State;
- the security and safeguarding of nuclear material;
- the liability for damage or injury caused to third parties;
- the compliance with international obligations.

Within the framework of the Nuclear Energy Act, fissile materials are defined as materials containing up to a certain percentage of uranium, plutonium or thorium (i.e. 0.1% uranium or plutonium and 3% thorium by weight). All other materials containing radionuclides and exceeding the exemption levels, are defined as radioactive materials.

Three areas of application of the Nuclear Energy Act
As far as nuclear facilities are concerned, the Nuclear Energy Act covers three distinct areas relating to the use of fissile materials, including spent fuel, 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 fissile 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 fissile materials and ores. The ANVS is responsible for maintaining the register.

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

3. Licences are also required for building, commissioning, operating and decommissioning nuclear installations (Section 15, sub b).

In theory, a licence to build a nuclear installation may be issued separately from a licence to actually commission it. However, the licensing of the construction of a radioactive waste or spent fuel management facility addresses more than the construction work. Account will have to be taken of all activities to be conducted in the installation, during and after its construction. The authorities need 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 to be conducted in the installation.

Amendments to a licence will be needed where planned modifications of an installation invalidate the earlier description of it. The licence for the decommissioning of nuclear facilities is regarded as a special form of modification and is treated as such. Refer to section 19.2.(i) for the Bkse decree, that provides more guidance on decommissioning issues.

The Nuclear Energy Act includes a separate chapter (Chapter VI) on intervention and emergency planning and response.

Amendments to the Act
Since the last national report, the Nuclear Energy Act and subordinate regulation were updated with the legal establishment of the ANVS as an independent administrative authority (Dutch acronym: zbo[38]). The ANVS as a zbo is independent in its functioning and organising its activities, but the Minister of Infrastructure and Water Management remains politically responsible for its functioning and is accountable to the Parliament.

Environmental Protection Act (Wm)

In the case of non-nuclear facilities, the Environmental Protection Act (Dutch: Wet milieubeheer, Wm) regulates environmental issues (e.g. chemical substances, smell and noise).

According to this Act and the associated Environmental Impact Assessment Decree, the licensing procedure for the construction of a nuclear facility includes a requirement to draft an Environmental Impact Assessment (EIA) report. An assessment on the significance of the environmental impact is required, for instance, in situations involving:
- a change in the type, quantity or enrichment of the fuel used;
- an increase in the release of radioactive effluents;
- an increase in the on-site storage of spent fuel;
- decommissioning.

The Environmental Protection Act states that under certain conditions (depending on size and nature of modifications), an independent Commission for Environmental Assessments must be established - and in these cases it should be consulted when it is decided that an EIA needs to be submitted. The dedicated organisation for this procedure, is called 'Commissie voor de m.e.r.' (Cmer[39]). The types of activities for which such assessments are required are specified in the Decree. The Cmer can be asked to advise on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear facilities.

The general public and interest groups often use EIAs as a basis for commenting on and raising objections to decisions on nuclear activities.

General Administrative Act (Awb)

The General Administrative Act (Dutch: Algemene wet bestuursrecht, Awb) is the 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 in administrative law. It thus also details the general procedures for the oversight and the enforcement and related to the latter the possible sanctions.

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/or local press. Under the Awb, documents provided with an application for a licence are to be made available for inspection by the public. Any stakeholder is free to lodge written or oral opinions, or by email on the draft decision and to ask for a hearing. All views made to the draft version of the decision are taken into account in the final version. Any stakeholder that has expressed views to the draft decision is free to appeal to the Council of State (the highest administrative court in the Netherlands) against the decision by which the licence is eventually granted, amended or withdrawn.

Specific requirements for the publication of new regulations are also laid down in the Publication Act (Bekendmakingswet). All new acts and governmental decrees are published on the internet and in the Official Journal ('Staatsblad') after enactment by the parliament. Announcements of new regulations have to be published in the Government Gazette.

38 zbo, 'zelfstandig bestuurs orgaan'or independent administrative authority.
39 http://www.commissiemer.nl/english.

Act on Government Information (Wob)

Under the Dutch Government Information (Public Access) Act (Dutch: Wet openbaarheid van Bestuur, 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[40]. 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.

Water Act (Ww)

The purpose of the Water Act (Dutch: Waterwet, Ww) is to prevent and where necessary, limit flooding, swamping and water shortage. Furthermore, it is meant to protect and improve the chemical and ecological status of water systems and to allow water systems to fulfil societal and ecological functions.

Nuclear installations need a permit under the Water Act to licence their direct (nonradioactive) discharges to the surface water.

Environmental Permitting (General Provisions) Act (Wabo)

Some 25 existing systems for issuing permits, licences, exemptions and so on for location bound (non-nuclear) activities which have an impact on our physical environment, have been replaced (October 2010) by a single environmental licence. The main purpose is to establish a single, straightforward procedure with one set of rules for persons or businesses seeking permission for activities which affect the physical environment. This includes one application form to fill in, one single competent authority, one supervision and enforcement authority and one procedure for objections and appeals. The goal is to simplify licensing systems and reduction of expenses for the applicants.

The civil engineering part of the construction of a nuclear installation and local spatial planning aspects will be licenced under the Wabo or the Spatial Planning Act ('Wet ruimtelijke ordening') by local authorities on the level of towns or rural municipalities. The nuclear safety and radiation protection aspects will be licenced under the Nuclear Energy Act by the Regulatory Body.

Safety Regions Act ('Wet veiligheidsregio's', Wvr)

The Safety Regions Act (Dutch: Wet veiligheidsregio's', Wvr) seeks to achieve an efficient and high-quality organisation of the fire services, medical assistance and crisis management under one regional management board.

Ratification of international conventions and legal instruments related to the management of radioactive waste and spent fuel

In addition to the JC, the Netherlands is party to many other Treaties and Conventions relating to the use of nuclear technology and radioactive materials. This is illustrated by the following list.

Non-proliferation: the Netherlands is party to the 'Treaty on the Non-Proliferation of Nuclear Weapons', the non-proliferation treaty of the UN. Related to this are the guidelines from the 'Nuclear Suppliers Group' that lay down restrictions on the transfer of sensitive nuclear techniques such as enrichment and reprocessing Furthermore the Netherlands is a party to the safeguards agreement between the IAEA, Euratom and Euratom's non-nuclear weapon Member States (INFCIRC/193) and has in force the Additional Protocol (AP, INFCIRC/540) and the Comprehensive Safeguards Agreement (CS, INFCIRC/153). In addition, the Netherlands is affiliated to the 'Proliferation Security Initiative' (PSI), based on Resolution 1540 of the UN Security Council for the Non-proliferation of Weapons of Mass Destruction[41].
Nuclear safety: the Netherlands is party to the UN Convention on Nuclear Safety, the CNS.

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

[41] UN Security Council Resolution 1540 (UNSCR 1540) for the non-proliferation of Weapons of Mass Destruction (WMD).

(Radioactive) Waste management: the Netherlands is party to the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive waste management[42].

Physical protection: the Netherlands is party to the Convention on Physical Protection of Nuclear Material and Nuclear Facilities[43]. In addition, the Netherlands has also expressed its support for the following 'Codes of Conduct':
- 'Code of Conduct on the Safety and Security of Radioactive Sources' (published
- 2004, IAEA);
- 'Code of Conduct on the Safety of Research Reactors' (published 2004, IAEA).

For all EU countries, EU legislation has a large impact on the national legislation. Examples are given below.

The Netherlands has transposed Council Directive 2009/71/Euratom of 25 June 2009 on nuclear safety in its national legislation force[44] in 2011. The safety objectives of the Directive cover those of the Nuclear Safety Convention and are in some regards more specific and have a larger scope.

The Directive 2009/71/Euratom ('Nuclear Safety Directive', NSD) prescribes the systematic evaluation and investigation of the nuclear safety of nuclear installations during their operating life possibly leading to improvements in the installation ('continuous improvement'). Also, the regulation prescribes inter alia that:
- Licence holders should give sufficient priority to nuclear safety systems;
- Licence holders must provide adequate human and financial resources to meet the obligations on the nuclear safety of a nuclear installation;
- All parties, including the licence holder, are required to provide a mechanism for educating and training their staff responsible for the safety of nuclear installations to meet the expertise and competence in the field of nuclear safety to be maintained and developed.

Post-Fukushima, the EU amended its NSD in 2014[45]. The amended Directive was developed considering various reviews, and reinforces several provisions of the 2009 NSD, such as[46]:
- Strengthens the role of national regulatory authorities by ensuring their independence from national governments. EU countries must provide the regulators with sufficient legal powers, staff, and financial resources.
- Creates a system of topical peer reviews. EU countries choose a common nuclear safety topic every six years and organise a national safety assessment on it. They then submit their assessment to other countries for review. The findings of these peer reviews are made public.
- Requires a safety re-evaluation for all nuclear installations to be conducted at least once every 10 years.
- Increases transparency by requiring operators of nuclear installations to release information to the public, both in times of normal operation and in case of incidents.

The transposition of the amended Nuclear Safety Directive in Dutch legislation was prepared in 2016 and was completed in 2017[47] and resulted in a new Ministerial Decree on Nuclear Safety (MR-NV).

The Netherlands has transposed Council Directive 2011/70/Euratom of 19 July 2011 'establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste'. Directive 2011/70/Euratom has been fully implemented in the Decree on Basic Safety Standards Radiation Protection (Bbs) and in the Nuclear Installations,

42 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, (JC).

43 Convention on Physical Protection of Nuclear Material and Nuclear Facilities. This is the amended version of the Convention on Physical Protection of Nuclear Material (CPPNM), the amendment having entered into force on 8 May 2016.

44 Regulation of the Minister of Economic Affairs, Agriculture (EL&I) and Innovation and the Minister of Social Affairs and Labour of 18 July 2011, No WJZ/11014550, concerning the implementation of Directive No 2009/71/Euratom of the Council of the European Union 25 June 2009 establishing a Community framework for nuclear safety of nuclear installations (PB EU L 172/18). In 2011, implementation was done via a temporary ordinance (Stcrt. 2011, nr.12517), which was made permanent in 2013 (Stcrt. 2013, nr. 14320).

45 The Safety Directive was amended by 'Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations'.

46 2015, Report of ENSREG, HLG_p(2015-31)_145.

47 https://eur-lex.europa.eu/legal-content/NL/NIM/?uri=CELEX:32014L0087.

Fissionable Materials and Ores Decree (Bkse). The Netherlands has drafted the required 'National Programme on radioactive waste and spent fuel' according to the definition provided by this Directive.

The Netherlands has transposed 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. For more information on this, refer to the section 19.2(i) in which more information can be found on the Basic Safety Standards Radiation Protection Decree, which is a new Decree, replacing the former Radiation Protection Decree.

19.1.c Special agreements

Special agreements – reprocessing spent fuel
For more information on the special agreements on reprocessing of spent fuel from the Borssele NPP, see section on Article 32.1 (ii).

19.2 Provisions in the legislative and regulatory framework

19.2.(i) National safety requirements and regulations

This section describes the regulatory framework, focusing on all levels below the top-level (Law) as portrayed in aforementioned legal hierarchy (Section, 19.1.a., Figure 5).

In short, the following categories will be discussed in this section:
- (Governmental) Decrees (Dutch: 'Besluiten');
- Ministerial Decrees (Dutch: 'Ministeriële regelingen');
- ANVS regulations;
- Dutch Safety Requirements, like the 'Nucleaire Veiligheidsregels', NVR's. NVR's are amended IAEA Requirements or Guides. Since they are not included in a
- Ministerial Decree or in the licence of a nuclear installation, they are not legally
- binding, and they should then be considered as Guidelines. This is applicable for new NPP or RR projects. Apart from amended IAEA standards, there are also other Guidelines (see next category);
- Guidelines on various issues, non-binding documents published by the ANVS to aid licence holders to meet the RB's expectations. When needed, like NVR's these can be referred to in the licence conditions and as such become a legally binding part of these. Guidelines can also be applied to existing nuclear installations as a reference (e.g. in PSRs);
- Codes and Standards of industry.

Governmental Decrees ('Besluiten')

A number of Governmental Decrees[48] have been issued containing additional regulations and these continue to be updated in the light of ongoing developments. Important examples of these in relation to radioactive waste and spent fuel and the safety aspects of nuclear installations are:
- the Transport of Fissionable Materials, Ores and Radioactive Substances Decree (Bvser);
- the Decree on the import, export and transit of radioactive waste and spent fuel(Biudrabs);
- the Environmental Impact Assessment Decree;
- the Reimbursement Decree;
- the Basic Safety Standards Radiation Protection Decree (Bbs);
- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse);
- the Radioactive Scrap Detection Decree.

The Nuclear Energy Act and the aforementioned Decrees are fully in compliance with the relevant Euratom Directive laying down the basic safety standards for the protection of workers and the general public against the health risks associated with ionising radiation.

[48] In Dutch legislation they belong to the category: 'Algemene maatregelen van bestuur'

Transport of Fissionable Materials, Ores and Radioactive Substances Decree (Bvser)

The Transport of Fissionable Materials, Ores and Radioactive Substances Decree (Bvser) deals with the import, export and domestic transport of fissionable materials, ores and radioactive substances, including radioactive waste and spent fuel, by means of a reporting and licensing system.

Decree on the import, export and transit of radioactive waste and spent fuel (Biudrabs)

The import, export and transit of radioactive waste and spent fuel is regulated by the Decree on the import, export and transit of radioactive waste and spent fuel. This Decree is the implementation of the Euratom directive 2006/117, and is aimed to control shipments of waste between EU Member States and between EU Member States and countries outside the EU.

Environmental Impact Assessment Decree

The Environmental Impact Assessment Decree, in combination with the Environmental Protection Act, stipulates that in certain circumstances a licence application for a nuclear installation shall be accompanied by an EIA. This complies with EU Council Directive 97/11/EC.

Reimbursement Decree

Current regulation already provides for limited reimbursement of the RB for the costs of oversight and licencing. The licence holders pay an annual fee and on top of this, and extra fees are paid for individual licencing activities.

Decree on Basic Safety Standards Radiation Protection (Bbs)

The Bbs 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, including radioactive waste, and radiation-emitting devices, and prescribes general rules for their application.

The Netherlands has transposed Council Directive 2013/59/Euratom[49], laying down basic safety standards for protection against the dangers arising from exposure to radiation, in its national legislation. On 6 February 2018, the Decree on Basic Safety Standards for Radiation Protection (In Dutch: “Besluit basisveiligheidsnormen stralingsbescherming”) and the following underlying regulations have come into force:
- Regulation on Basic Safety Standards for Radiation Protection (in Dutch: “Regeling basisveiligheidsnormen stralingsbescherming”);
- Regulation on Radiation Protection for Occupational Exposure (in Dutch: “Regeling stralingsbescherming beroepsmatige blootstelling”);
- Regulation on Radiation Protection for Medical Exposure (in Dutch: “Regeling stralingsbescherming medische blootstelling”);
- ANVS-regulation on Basic Safety Standards for Radiation Protection (In Dutch: “ANVS-Verordening basisveiligheidsnormen stralingsbescherming”).

The implementation led to the introduction of a situation based approach (planned, emergency and existing situations), as prescribed in the Basic Safety Standards Directive. Another change was the introduction of “registration” as one of the two instruments to authorise practices using ionising radiation. Licensing is the other instrument to authorise practices.

This Decree also regulates the requirements for the recycling or disposal of unsealed or sealed sources that are no longer used. Additional requirements for High-Activity Sealed Sources and orphan sources are also laid down in this Decree.

[49] 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.

The Bbs and dose criteria for normal operation
Main elements of the Bbs are: (1) justification of the activity, (2) optimization - ALARA and (3) dose limits. Practices involving ionizing radiation should be justified. Dutch regulation features a list of 'justified and not justified practices'.

The exposure to ionising radiation should be kept As Low As Reasonably Achievable (ALARA). The ALARA principle is also recorded in the Nuclear Energy Act (article 15c sub3 and 31), the Bbs Decree and in the Bkse Decree.

The dose limit for members of the public 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. NPP's, isotope laboratories, sealed sources, X-ray machines, industries), thus excluding natural background and medical exposures. For a single source (for instance a single NPP), the maximum individual dose is set at 0.1 mSv per annum. An application for authorisation will always be refused if the practice results in an effective public dose higher than 0.1 mSv per year.

The Nuclear Installations, Fissionable Materials and Ores Decree stipulates that the relevant sections of the Bbs and the underlying regulations about the protection against ionizing radiation also apply to fissionable materials, including spent fuel.

The Bbs and radioactive waste
The Bbs 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 remove the radioactive material from the site without a licence in only a limited number of ways:

If the material is not declared as waste:
- if the (activity) concentration is below the general 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;
- in case of NORM, there are some possibilities to enable reuse of these materials; 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 the material is 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;
- by transfer to another designated organisation (landfills) for the collection of radioactive waste;
- In the case of specific clearance, other options than a transfer to COVRA are possible when the material is below the specific clearance level.

Licence holders 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.

Nuclear Installations, Fissionable Materials and Ores Decree ('Besluit kerninstallaties, splijtstoffen en ertsen', Bkse)

The Bkse and licensing construction, commissioning & operation
The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) regulates all practices involving fissionable materials, including spent fuel, and nuclear facilities (including licensing).

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 facility for the storage of fissionable materials, including spent fuel , and associated requirements. According to article 8 of Bkse, for such an application, applicants are required to submit (among others) the following information:
- a description of the site where the installation is to be located, including a statement of all relevant geographical, geological, climatological and other conditions;

- 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 at any one time;
- 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).

The Bkse and decommissioning

The Bkse includes legislation on decommissioning and financial provisions for the costs of Decommissioning of nuclear installations. An important part of this legislation was based on the WENRA[50].

Safety Reference Levels on decommissioning

The Bkse requires the licence holder 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 of approval of the ANVS. The Bkse specifies the minimum requirements on the content of the decommissioning plan. The decommissioning plan sets out safety conditions for all the activities carried out during the decommissioning phase, and it provides the basis for the financial provisions for the decommissioning costs.

For the application for a decommissioning licence, according to Bkse, the licence holder shall submit the following information to the authorities:

- A copy of the operating licence;
- A decommissioning plan;
- 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 facility 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.

The Bkse and the risk criteria for incidents and accidents

In the Netherlands a “risk policy” applies aiming at reducing risks posed by any hazardous activity and including nuclear installations[51]. This policy is primarily incorporated in the Bkse Decree.

As far as the radiological hazard is concerned, the regulations can be seen as implementing the IAEA Fundamental Safety Standards (IAEA SF-1), in particular implementing the primary ‘Safety Objective’: ‘The fundamental safety objective is to protect people and the environment’.

The application according to Bkse of this objective requires the licence holder to:

- Verify that pre-set criteria and objectives for individual and societal risk have been met. This includes identifying, quantifying and assessing the risk;
- Reduce the risk, if required, until an optimum level is reached (based on the ALARA principle);
- Exercise control, i.e. maintain the level of risk at this optimum level.

[50] Western European Safety Regulators Association, WENRA.

[51] Formulated by the former Ministry of VROM, for the scope of the JC, the predecessor of the Ministry of Infrastructure and Water Management.

Ministerial Decrees ('Ministeriële Regelingen, MR')

Ministerial Decrees are issued by the Minister of Infrastructure and Water Management and are mandatory for all nuclear installations and activities. In this section, only a selection of Ministerial Decrees relevant in the context of the Joint Convention and as far as not mentioned previously is discussed.

Ministerial Decree on 'Nuclear Safety'
Notable is the transposition of the Council Directive 2014/87/Euratom of 8 July 2014, amending Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations and covering more or less the safety objectives of the CNS. The transposition of the amended Nuclear Safety Directive resulted in a new Ministerial Decree on Nuclear Safety 14 June 2017 (the 'MRNV').

Regulations and guides issued by Regulatory Body

The Nuclear Safety Rules (NVR's)
The Nuclear Safety Rules (Dutch: 'Nucleaire VeiligheidsRegels', NVR's) are legally binding for an installation or nuclear facility, when they are referred to in licences through a licence condition. This mechanism allows the ANVS to enforce the NVR's. The practice of including requirements in the licence instead of general rules is suitable for a country like the Netherlands with a very small number of nuclear facilities and only one operating NPP. NVR's are part of the licence of the NPP for already more than 30 years.

NVR's, adapted to the use in the Dutch nuclear facilities
The NVR's are based on the Safety Standards and Guides issued by the IAEA. These IAEA documents have been assessed to determine how they can be applied in the Netherlands. This has resulted in a series of adaptations (termed 'amendments') to the IAEA documents, which then have become the NVR's. The amendments have been formulated for various reasons: to allow a more precise choice out of different options, to give further guidance, to be more precise, to be more stringent, or to adapt the wordings to specific Dutch circumstances like risk of flooding, population density, seismic activity and local industrial practices.

At the Safety Requirements level, the NVR's are strict requirements which must be followed thoroughly. At the Safety Guides level, the NVR's are less stringent: alternative methods may be used to achieve the same safety levels.

NVR's, consistency and recent update, 2014 - present
During the IRRS mission in late 2014 it was suggested to apply the NVR's to all nuclear installations. Recently the ANVS has studied ways to further implement IAEA Safety Requirements and Safety Guides in the regulatory framework. It was decided that in future, IAEA Safety Requirements will be implemented in the licences of all nuclear installations through licence conditions and in a ANVS policy rule for i.a. licence applicants. The IAEA Safety Guides will be used as guidelines. In the required implementation process, the WENRA Reference Levels will be considered as well. The timing of the process for implementation in the licences will be determined by the time table for the several licensing procedures.

Adopted international nuclear codes and standards

The experience with the IAEA-based NVR's has been generally positive, although improvements are still possible. Strong points are the clear top-down structure of the IAEA hierarchy of nuclear and radiation safety Standards and their comprehensiveness. However, given that they are the result of international cooperation, the standards cannot cover all aspects in the detail sometimes offered by some national (nuclear) regulatory systems. To cope with this difficulty, inspectors and assessors involved with their application, need to have an adequate knowledge of the current state of technology in the various areas relevant to safety. In addition, sometimes additional material is needed to define the licensing basis. Nuclear codes and standards of other countries are often used. Examples are the US Code of Federal Regulations, the US NRC Regulatory Guides, the US NRC Standard Review Plan, and the German RSK recommendations. However, careful consideration needs to be given to application of these foreign standards, since using them out of their original context may lead to difficulties.

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 Safety Reference Levels for storage of radioactive waste and spent fuel and for decommissioning are relevant; these have to be implemented 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 ANVS participates in the WENRA Working Group on Waste and Decommissioning.

Adopted industrial standards

The Safety Guides in the NVR series give guidance on many specific subjects. However, they do not replace industrial codes and standards. Applicants are therefore required to propose applicable codes and standards, to be reviewed by the RB as part of their applications. Codes and standards in common use in major nuclear countries are generally acceptable (e.g. ASME, IEEE and KTA). The RB has the power to formulate additional requirements if necessary.

19.2.(ii) System of licensing

As discussed in the section on Article 19.1 of the Convention, the Nuclear Energy Act stipulates (in Article 15, sub b) that a licence must be obtained to construct, commission, operate, modify or decommission a nuclear facility.

Similarly, the Act states (in Article 15, sub a) that a licence is required to import, export, possess or dispose of fissionable material. Under Article 29 of the same Act, a licence is required in a number of cases (identified in the Decree on Basic Safety Standards Radiation Protection (Bbs) for the preparation, transport, possession, import or disposal of radioactive material, including radioactive waste.

The procedures to obtain a licence under the Nuclear Energy Act (and other acts), follow
the procedures 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. The Regulatory Body shall take notice of all views expressed and respond to them with careful reasoning. If the reply is not satisfactory, the decision of the RB can be challenged in court.

In line with its policy on transparency, the ANVS has published a document on its website, that describes its licensing policy. It also has published a document on its supervision and enforcement policy. There are more guidance documents, that aid licence holders and applicants in submitting licence applications. This all aids to improve the interaction between the ANVS and the licence holders, and make it more efficient. Refer to section 20.1.j for more information on such policy documents.

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 (NVR's) can be referred to as well as other nuclear codes and standards. If necessary a tailor-made approach can be employed.

Principal responsible authority
The authorities relevant with respect to the regulatory process under the Nuclear Energy Act have been described in the section on Article 19.1. 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.

Advisory bodies
The Health Council of the Netherlands (Gezondheidsraad) is an independent scientific advisory body established under the terms of the Public Health Act. Its remit is to advise the government and Parliament on the current level of knowledge with respect to public health issues and health (services) research, including radiation protection.
To date there is no standing advisory committee on nuclear safety for the licensing

process; an advisory committee can be formed on an ad hoc basis as required. The RB at any time can install a Commission dedicated to any required issue. However, there is an Advisory Board which has the task of providing the ANVS with solicited and unsolicited advice on matters related to the tasks of the ANVS. Refer to the text on Article 20 in the present report, section 20.1.a.

With a licence application, it very often is compulsory to conduct an Environmental Impact Assessment or EIA (Dutch: milieu-effectrapportage, m.e.r.). It is compulsory for facilities for the treatment, storage or disposal of spent fuel or radioactive waste. The Netherlands has a permanent commission, the Commission for the Environmental Assessment ('Commissie voor de m.e.r.', Cmer[52]) that advises the RB on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear facilities.

Specific licensing issues in the Nuclear Energy Act

Article 15b of the Nuclear Energy Act enumerates the interests for the protection of which a licence may be refused. These interests are listed in section 19.1.a. 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 that may be
set later by the ANVS.

In the case of very minor modifications, the licence holders may use a special provision in the Act (Article 17) that allows such modifications to be made with a minor licence change. With its licence application, the licence holder needs to submit a report describing the intended modification and its environmental impact. This instrument can only be used if the consequences of the modification for man and the environment are within the limits of the licence in force. There is no obligation to request views before the definitive licensing decision is issued. The licence is published in the Government Gazette and on the website of the ANVS. Stakeholders disagreeing with the decision may submit a complaint to the ANVS. If a stakeholder is not satisfied with the response by the ANVS, he may appeal to the Council of State (Dutch: 'Raad van State') against the licensing decision.

The ANVS conducts regular reviews to establish whether the restrictions and conditions under which a licence has been granted are still sufficient to protect workers, the public and the environment, taking account of any developments in nuclear safety that have occurred in the meantime. It should be noted that the regular reviews are not the same as the Periodic Safety Reviews (PSRs), which the licence holder is required to perform periodically (according to its licence). Article 19.1 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. Article 18a of the Nuclear Energy Act empowers the ANVS to compel the licence holder 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.

19.2 (iii) Regulatory assessment and inspections

Entities performing assessments and inspection

Article 58 of the Nuclear Energy Act provides the basis for entrusting designated officials with the task of performing nuclear safety supervision: safety assessment, inspection and enforcement. This is mainly the task of the inspectors of the ANVS in the Netherlands. Refer to section 20.1.c for a detailed description of the ANVS, its functioning, as well as recent developments.

Regulatory assessment process

With a licence application, the ANVS reviews and assesses the documentation submitted by the applicant. This might be the Environmental Impact Assessment (EIA) report and the Safety Analysis Report (SAR) with underlying safety analyses submitted in the context of a licence renewal application or modification request, proposals for design changes, procedural changes such as the introduction of Severe Accident Management Guidelines (SAMGs).

[52] http://www.commissiemer.nl/english.

There are proposed changes that are within the boundary of the licence, like requests for minor modifications and changes to the Technical Specifications. The assessments of these are carried out by the ANVS and have no need of a licence modification. During the licensing phase the ANVS assesses among others, whether the applicable NVR's (i.e. requirements and guidelines for nuclear safety and environment), the requirements and guidelines for security and the regulation for non-nuclear environmental protection have been met and whether the assessments (methods and input data) have been prepared according to the state-of-the-art. The ANVS assesses the radiological consequences associated with postulated transients[53] and accidents in the various installation plant categories. The ANVS will verify in particular if the results are permissible in view of the regulations. Its expertise enables the ANVS to determine the validity of the (system) analyses and the calculations. The ANVS receives support from a foreign TSO in these activities.

The ANVS lays down the guidelines for the required calculations (e.g. data for food consumption, dispersion). In the final stage of the licencing procedure, the inspectors of ANVS are asked to verify the draft licence including its licence conditions and requirements regarding its appropriateness for among others enforcement.

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[54] 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 licence holder 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 licence holder is conducting its activities in accordance with its quality assurance (QA) system;
- to check that the licence holder is conducting its activities in accordance with the best technical means and/or accepted industry standards.

In addition to inspection activities, international safety review missions take place. An important piece of information for inspection is the safety evaluation report, which is to be periodically updated. In this report the licence holder 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. Depending 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[55] requires continuous improvement of (nuclear) safety and the execution of periodic safety reviews. In line with this, a licence holder carries out periodic safety reviews as required by their 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.

53 Anticipated Operational Occurrences.
54 Dutch: 'Besluit aanwijzing en taakvervulling toezichthouders Kernenergiewet'.
55 Dutch: 'Regeling Nucleaire veiligheid kerninstallaties'.

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 order subject to a penalty. Article 18a of the Nuclear Energy Act empowers the ANVS to compel the licence holder 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 'Supervision and Intervention Strategy' on its website in 2017, to inform all licence holders. It among others describes the means of intervention available, a set of administrative proceedings and criminal proceedings. Examples of administrative proceedings described in the document are: formally addressing licence holder, 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 licence holder or prepare an official report for the public prosecutor, should the need occur.

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 section on Article 20.

The licence holders hold prime responsibility for the safe management of spent fuel 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[56] of the waste management activities have been centralised in one waste management organisation, COVRA. COVRA collects and manages the funds for the long-term interim storage and 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 Basic Safety Standards Radiation Protection Decree , the Bbs,[57] and has been provided in the text on Article 32.1 (v).
The policy on the management of spent fuel 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 as such that waste containing natural radionuclides (NORM) is covered by 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.

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56 Some NORM is managed in landfills.

57 Dutch: Besluit basisveiligheidsnormen stralingsbescherming, Bbs.

Article 20. Regulatory body

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

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

20 Regulatory Body

20.1 *Authority for Nuclear Safety and Radiation Protection*

20.1.a General

The RB is the authority designated by the Government as having legal authority for conducting the regulatory process, including issuing licences, and thereby regulating nuclear, radiation, radioactive waste and transport safety, nuclear security and safeguards.

There is one large entity, the Authority for Nuclear Safety and Radiation Protection (ANVS)[58] and some smaller entities at various ministries that together constitute the RB. However the regulatory tasks related to radioactive waste management which is the subject of this report are within the scope of the ANVS only. Therefore this report often will refer to the ANVS as the RB.

The ANVS brings together expertise in the fields of nuclear safety and radiation protection, emergency preparedness and response as well as security and safeguards. For each of these subjects, the ANVS focusses on preparing its own regulations (ANVS 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. The ANVS can also be requested by responsible ministries to give advice over policy and legislation issues (concerning nuclear safety and radiation protection). 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 tasks and mandates of the ANVS are described in Chapter II of the Nuclear Energy Act. In 2017 the ANVS obtained the formal status of an independent administrative body (Dutch acronym 'zbo'). The Authority is the competent authority in matters of nuclear safety, nuclear security, radiation protection, transport safety, and waste management and emergency preparedness and response. This type of independent administration explicitly satisfies the international requirements (EU-radioactive waste management directive and IAEA standards). The Minister of Infrastructure and Water Management bears ministerial responsibility for the ANVS.

Advisory Board

The ANVS appointed an Advisory Board[59] on 17 April 2018. The board has the task of providing the ANVS with solicited and unsolicited advice on matters related to the tasks of the ANVS. It has six members, with expertise relevant to the tasks of the ANVS. Thus far, the Advisory Board has presented two advices relevant to radioactive waste and spent fuel:

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58 Autoriteit voor Nucleaire Veiligheid en Stralingsbescherming, ANVS.

59 Dutch: Raad van Advies.

- *Advice on knowledge at the ANVS*
  The ANVS asked the Advisory Board to advise on how to ensure that sufficient knowledge remains available at the ANVS in an environment in which nuclear activities in Europe are being phased out. On March 25, 2019 the Board recommended the authority to promote a national nuclear knowledge management programme in the Netherlands in co-operation with relevant stakeholders. The programme should:
  1. Promote the education of students with expertise relevant to the programme and their graduation in sufficient numbers;
  2. Develop appropriate additional expertise;
  3. Promote and maintain in particular the expertise on decommissioning.

Following up on this advice, the ANVS installed an independent Commission with the task to explore the support base and conditions to secure the knowledge infrastructure for nuclear safety and radiation protection. The independent Commission advised to:
1. Draw up a Knowledge and innovation Agenda Nuclear Technology and radiation;
2. Establish a National Platform Nuclear Technology and radiation and initiate an Impulse Programs in the area of awareness, research and education;
3. Establish a Human Resources Observatory on Nuclear Technology and Radiation;
4. Strengthen the horizontal Interdepartmental co-ordination on the level of officials.

As a next step a working group with officials of several Ministries has been asked to prepare a reaction on the advice with proposals for the next steps.

- *Advice on role ANVS around disposal*
  On 23 December 2019 the Board issued an advice on what the role of the ANVS around disposal of radioactive waste should be and how the distribution of responsibilities and tasks for the various sub-aspects of policy development, its implementation and realization of the disposal facility should be organised. In dialogue with the ANVS, the Board has identified three aspects that require special attention:
  1. The role of the ANVS in policy preparation for a national disposal facility;
  2. The role of the ANVS in securing and supervising financial resources;
  3. The role of the ANVS in policy preparation for a possible multinational disposal.

The Board has carried out a reflection on each aspect, providing recommendations and advise for next steps. The transfer of the responsibility for policy preparation (including the participation process) of disposal from ANVS to the Ministry of Infrastructure and Water Management is an important step forwards, the transfer ensures that the ANVS can focus on the regulation of safety aspects.

20.1.b Entities of the RB

Below the status and tasks of the entities of the RB are summarized:
- Since 2017, the ANVS is an independent administrative authority (zbo). The ANVS is involved in regulatory requirements, licensing and independent supervision (safety assessment, inspection and enforcement) of compliance by the licence holder(s) and other actors with the requirements on the safety, security and non-proliferation.[60] The ANVS can also be requested to give advice about legislation and policies on nuclear safety and radiation protection. Furthermore it has responsibilities regarding advising in the area of emergency preparedness and response, and public information and communication.
- The Inspectorate SZW[61] has tasks in the area of protection of the safety of workers against exposure to radiation.
- The Health and Youth Care Inspectorate (Ministry of VWS)[62] has tasks in the area of protection of patients against undesirable effects of exposure to radiation.
- The Dutch State Supervision of Mines (SodM, part of Ministry of Economic Affairs and Climate Policy, EZK) oversees the safe and environmentally sound exploration and exploitation of natural resources in the underground like natural gas and oil.

60 These requirements apply to activities and facilities (including nuclear facilities).
61 'Inspectorate Sociale Zaken en Werkgelegenheid', Ministry of Social Affairs and Employment.
62 'The Health and Youth Care Inspectorate', Ministry of Health, Welfare and Sport.

- The Netherlands Food and Consumer Product Safety Authority (NVWA)[63] monitors the quality of food and consumer products to safeguard human health and animal health and welfare. The NVWA supervises the whole production chain, from raw materials and processing aids to end products and consumption. The NVWA is an independent agency, part of the Ministry of Agriculture, Nature and Food Quality (LNV), and a delivery agency for the Ministry of Health, Welfare and Sport.
- The Inspectorate of the Ministry of Infrastructure and Water Management (ILT)[64] has general supervision responsibilities for the compliance with the requirements of modal transport regulations.
- The Inspectorate Military Healthcare (IMG)[65] of the Ministry of Defence oversees a healthy and safe work environment for its civilian and military staff. 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 Nuclear Energy Act-related tasks. In addition to day-to-day contacts between the entities of the RB, there are periodic meetings at managers and directors levels.

Cooperation agreements

As the RB consists of several entities covering certain aspects of radiation protection, a Cooperation Agreement for Radiation Protection (signed in 2017[66]) was set up between the ANVS and the policy departments and inspectorates of other ministries with tasks under the Nuclear Energy Act. The purpose of the Cooperation Agreement is to promote the cooperation between the various parties who have statutory duties in the area of radiation protection. This purpose is achieved by making working arrangements and by setting out the framework, these arrangements (made between two or more parties on the basis of the Cooperation Agreement) have to comply with. The working arrangements relate to interdepartmental (execution) policy development and –implementation, licensing, supervision and enforcement, communication, research and education, and participating and representation in international fora. The following parties signed the agreement: the ANVS, the Ministers of Infrastructure and Water Management (IandWM), Social Affairs and Employment (SZW), Health, Welfare and Sport (VWS), Defence, the Human Environment and Transport Inspectorate (ILT), the Inspectorate SZW (ISZW), the Healthcare Inspectorate (IGJ), the Inspectorate for Military Healthcare (IMGZ), the State Supervision of Mines (SodM), and the Netherlands Food and Consumer Product Safety Authority (NVWA).

In 2019 a working arrangement was concluded between the Ministries of VWS, SZW and ANVS regarding (execution) policy development and -implementation, exchange of information, external communication and participation in international fora. Also, a Covenant is concluded in 2018 between the ANVS, the Minister of Infrastructure and Water Management, and the Minister of Finance, regarding the legal tasks of the ANVS that are conducted by the Customs. With this Covenant, legal requirements[67] will be met regarding the non-fiscal tasks that customs undertake in order to control European cross border transport of goods under the scope of the Nuclear Energy Act. Furthermore, a covenant between the Police and the ANVS was concluded in the 1990's on secured nuclear transport.

Working arrangements between the ANVS and the inspectorates SZW, IGJ, ILT and Defence are scheduled for 2020-2021.

The ANVS has agreements with several foreign RBs. Examples are a MoU with Belgian counterpart FANC (2017), a cooperation agreement with the Australian counterpart ARPANSA (2018) and an extension Arrangement with the US NRC. The latter is an extension of an agreement signed in 2013.

63 'Netherlands Food and Consumer Product Safety Authority; Ministry of Agriculture, Nature and Food Quality.
64 Dutch: 'Inspectie Leefomgeving en Transport', ILT.
65 Dutch: 'Inspectie Militaire Gezondheidszorg', IMG.
66 Signed on 28 September 2017.
67 Legal requirements of article 1:3, paragraph 5 of the General Customs Law.

Responsibilities for safety of spent fuel management and radioactive management facilities
Prime responsibility for nuclear safety of a nuclear facility rests with the licence holder. 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[68].

The Netherlands have implemented European Council Directive 2011/70/Euratom establishing a community framework for the safe management of spent fuel and radioactive waste. The Directive 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.

This Directive requires the allocation of responsibility to the bodies involved in the different steps of spent fuel and radioactive waste management. In particular, the national framework shall give primary responsibility for the spent fuel and radioactive waste to their generators or, under specific circumstances, to a licence holder to whom this responsibility has been entrusted by competent bodies. An example of the latter is COVRA which takes over responsibility after accepting spent fuel or radioactive waste from licence holders.

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 and approved. The licence is granted by the ANVS under the Nuclear Energy Act. The ANVS 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.

20.1.c Regulatory Body – tasks

The ANVS has several tasks regarding nuclear safety and radiation protection and associated emergency preparedness and response, and security and safeguards as meant in conventions of the IAEA:
- Granting licences; all nuclear facilities in the Netherlands, operate under licence, awarded after a safety assessment has been carried out successfully. Licences are granted by the ANVS under the Nuclear Energy Act;
- Regulating all other radiation practices by licensing or notification and registration;
- Supervising and enforcing compliance with requirements by or under the Nuclear Energy Act;
- Advise to the Ministry of Infrastructure and Water Management on policies and Acts and regulations;
- Together with various partners maintaining an Emergency Preparedness and Response organisation;
- Informing interested parties and the general public;
- Participating in relevant activities of international organisations, as far as related to tasks related to the Nuclear Energy Act;
- Maintaining relationships with comparable foreign authorities and relevant national and international organisations;
- Supporting national organisations with the provision of expertise and knowledge;
- Undertaking research in support of the implementation of its tasks.

Further integration of safety and security inspections is being stimulated and practiced. The basic key to deploying staff to the different types of nuclear installations is the potential safety risk. But other factors also have an impact, like operational occurrences and incidents, inspection findings or public attention.

[68] 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)'.

20.1.d Organisation of the ANVS

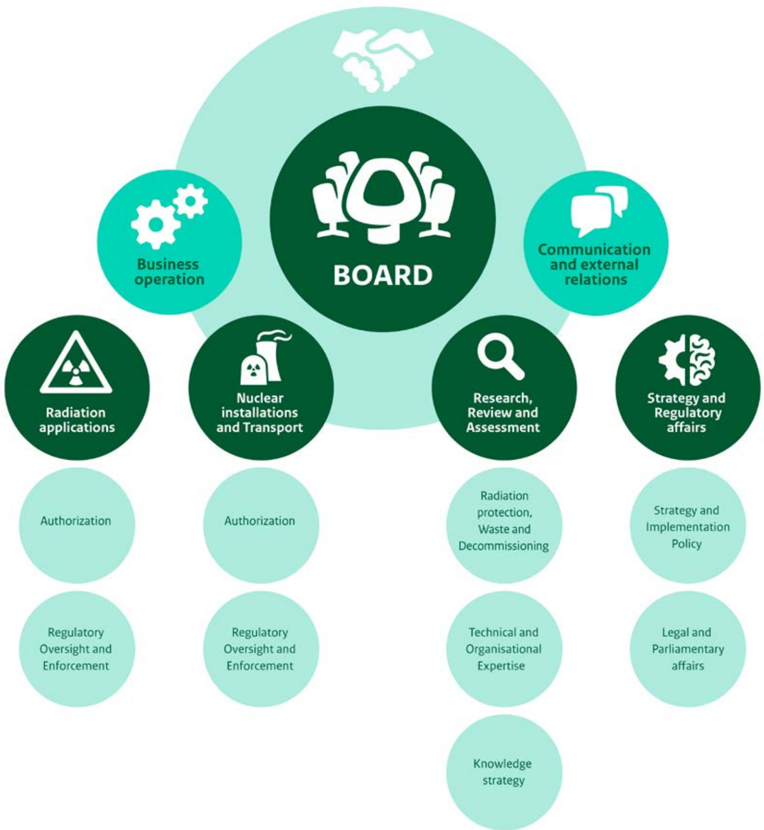
Organisation of the Authority
The ANVS is led by a Board with two Members: a chairman and a co-chairman, and has six departments. In implementing its tasks, the ANVS can rely on support from various organisations, listed below in section 20.1.l 'External Technical Support'.
- The Board Members have been officially appointed as the independent RB (ZBO);
- The staff of the ANVS are civil servants of the Ministry of Infrastructure and Water Management, and are available to the board as ANVS staff members.

In 2018 and 2019 two evaluations of the ANVS, one internal and one external, were conducted. Periodic external evaluations of independent administrative bodies like the ANVS are a legal obligation. This external evaluation was conducted under the auspices of the Ministry of Infrastructure and Water Management.

To further improve the ANVS, two actions were taken:
- Reorganization of ANVS. This reorganization was completed by January 1st, 2020, leading to the new structure with six departments;
- Transferring the responsibility for the task 'Policy preparation' to the Ministry of Infrastructure and Water Management. The change came into effect on May 15th 2020.

Below (see Figure 5), the organisation chart of the ANVS is presented.

Figure 5: Organisation chart of the ANVS



The structure aims to achieve the following goals:
- Improving the connection to parties relevant to the ANVS;
- Improve internal cooperation within the ANVS by strengthening interdependencies between the departments and building on trust;
- Strengthen the image of the ANVS and its role as a regulatory body;
- Strengthen the ANVS' knowledge management function;
- Transfer from optimisation of work in the task areas 'Nuclear Safety' and 'Radiation Protection' to optimisation of ANVS-wide issues;
- Make certain functions (licensing versus supervision, policy preparation versus policy execution) more distinct from each other;
- Pursue unity within ANVS: broad thinking and working with flexible deployment of staff within the ANVS-organisation.

The Minister of Infrastructure and Water Management has informed the Dutch Parliament in January 2020 about the external evaluation and the consequences of the recommendations therein. In particular, the Minister mentions that, as a consequence of the transfer of the responsibility for policy development, the Ministry of Infrastructure and Water Management will create a new entity within the Ministry and that the shape and size have been established in consultation with the ANVS to avoid fragmentation of the expertise that continues to be needed within ANVS.

The new entity 'Nuclear Safety and Radiation Protection' resides within the existing Environmental Safety and Risks Directorate[69]. A number of ANVS staff members has moved to this entity. This further supports the aim of the ANVS and the new entity at the Ministry of Infrastructure and Water Management to strengthen the professional relation and cooperation. This reorganisation will be evaluated after one year.

20.1.e ANVS licensing, supervision and enforcement policies

The ANVS has documented its policies on licensing, supervision and enforcement. The top-level documents have been published on the ANVS website, to fulfil the ANVS' principle of 'openness and transparency of regulatory activities' (also see section 20.1.j). In this way licence holders and the public are informed about the approach taken by the ANVS and its guiding principles. For ANVS staff, there is more detailed information on working procedures available as well (also see section 20.1.i on quality management).

In the Netherlands, supervision and enforcement in the field of nuclear safety is also conducted by the ANVS. Supervision and enforcement in the field of radiation protection is conducted by the ANVS together with various Inspectorates, to the extent that this is within their authority. The ANVS also cooperates with the Dutch Customs. Some of ANVS' guiding principles regarding licensing, as well as supervision and enforcement are:
- Priority to safety, all the efforts of the ANVS serve the protection of people, animals, plants and property. This is more than just verifying compliance with regulatory requirements. Also, security and prevention of the proliferation of knowledge and radioactive materials (for unauthorized purposes) are an essential element of safety.
- Responsibility at the licence holder and justified trust. The licence holder is responsible for (nuclear) safety. This responsibility cannot be transferred to the Regulatory Body, but the ANVS supervises the licence holders and assesses if the trust vested in the licence holders is justifiable.
- Emphasis on continuous improvement. The safety must remain 'state-of-the-art'. A changing environment, technological advances, lessons learnt from incidents and accidents, all may lead to improvements. The ANVS also requires the licence holders to keep risks as low as reasonably achievable (ALARA).
- Risk-oriented approach or graded approach in the execution of the ANVS' tasks to aid efficient management of available resources at the ANVS.
- Coordination and cooperation with partners and stakeholders is essential for the proper execution of the tasks of the ANVS.

[69] The Environmental Safety and Risks Directorate is part of the larger entity, the Directorate-General for Environment and International Affairs of the Ministry of Infrastructure and Water Management.

With regard to licensing, the ANVS applies the ‘comply or explain’ principle, meaning the applicant must demonstrate compliance with published regulation. If the applicant cannot meet these requirements exactly as prescribed, he will need to demonstrate how he will meet the objectives of the requirements in an equivalent way.

20.1.f Coordination of activities for managing nuclear accidents and incidents

Refer to the text on Article 25 on emergency preparedness and response for the relevant details.

20.1.g Development and maintenance of Human Resources and competence

Current manpower situation of the ANVS
During the IRRS mission of November 2014, IAEA recommended to assess the sufficiency of the staffing levels of the regulatory body. During the parliamentary debate on the legal establishment of the ANVS in 2016, the Minister of (then) Infrastructure and the Environment agreed to have the manpower situation studied and report the results to Parliament. In 2016 the tasks and costs of the ANVS were evaluated, including its required staffing level. ANVS started 2020 with 131 employees (2019: 126) representing 124 FTE (2019: 119,3) and an externally hired staff of 12 persons (2019: 14), representing 7 FTE (2019: 6).

Disciplines and training
The expertise of the ANVS spans disciplines in areas like radiation protection, nuclear safety, waste safety, transport safety, conventional safety, risk assessment, security and safeguards, emergency preparedness and response, legal and licensing aspects. Recently it has been decided that the ANVS needed more expertise for a number of financial topics. Other disciplines that needed further development were decommissioning, knowledge management and public communication. Therefore ANVS has contracted staff with the necessary expertise in these areas. When needed, knowledgeable consultants are contracted for support.

The ANVS provides tailor-made training for its staff. Experts have to keep up to date with developments in their discipline. Apart from the general courses, training dedicated to the technical disciplines in the areas of nuclear safety, radiation protection and emergency preparedness and response is provided. This includes international workshops, but also conferences and visits to other regulatory bodies. In addition, information exchange takes place through the international networks of OECD/NEA, IAEA, EU et cetera. To be mentioned are the contributions to HERCA, WENRA, ENSREG, TRANSSC, RASSC, WASSC, NUSSC, EPRSC, NEA/CNRA, NEA/CSNI and several of its Working Groups. Furthermore there is a policy to participate in several IAEA missions annually, like in IRRS, ARTEMIS, IPPAS, EPREV, INSARR. It is considered to be worthwhile to have staff positioned at IAEA, NEA or EU; however this has not yet materialised.

All ANVS staff follow trainings for their work and maintain training plans that are assessed at least annually with their team leader. In addition to formal education courses, the ANVS utilizes informal, voluntary learning opportunities, including presentations and workshops. The ANVS is also conducting a competence gap analysis, through an employee knowledge survey, to assess the organization’s education and development capabilities.

Staff requiring specific expertise, such as inspectors, receive the specific training required and participate in a mentoring program with more experienced staff before completing work on their own. In addition, they are provided with the training and information required to safely complete their tasks in the various work environments that they may encounter. The inspector qualification process includes instruction for all the procedures necessary to complete inspections and practical experience in the field, combined with the evaluation by a senior inspector. Inspectors also receive training on a comprehensive range of potential workplace hazards that they may encounter, both general (such as chemicals and physical hazards) as well as specific hazards related to the physical locations where they may conduct their inspections. Through this training program, the ANVS fulfils its duty of care to these workers and ensures their ongoing safety through education.

Contracted support and cooperations
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. This is considered one of the basic policies of the ANVS: the core disciplines should be available in-house, while the remaining work is subcontracted to third parties like governmental

research organisations and/or commercial Technical Support Organisations (TSOs). Also when more resources are needed to meet peak demands, contracting third parties is an option.

The ANVS cooperates with other national and regional authorities and organisations, like the Human environment and Transport 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. More about contracted support can be found in section 20.1.l 'External Technical Support'.

20.1.h Financial resources

The State Budget allocates funds for implementing the duties, responsibilities and powers associated with nuclear safety and radiation protection. These resources are also
intended to facilitate permanent compliance with quality and expertise requirements in the area of nuclear safety and radiation protection.

Specifically for the ANVS, the Nuclear Energy Act stipulates that the Ministry of Infrastructure and Water Management will allocate sufficient financial resources for the ANVS to carry out its duties.
Since 2015 the ANVS had a dedicated budget. The budget at that time was the sum of the budgets of the merged entities. The annual budget in 2020 was € 29.8 million. The budget of the ANVS for contracted support was about € 10.1 million, mostly spent on contracted support provided by organisations like RIVM, GRS and NRG.[70]

20.1.i Quality management system of the RB – ANVS Integrated Management System (AIM)

Since the merger of the former separate entities of the RB in 2015, the new management system of the ANVS is under development. Recommendations from the IRRS mission and follow-up mission are being incorporated in the new system, which is the ANVS Integral Management System, the AIM.[71]

There is a central AIM-document, describing the working procedures and processes and the main documents of the management system. It also describes how its achievements in terms of Key Performance Indicators (KPIs) need to be monitored. The AIM demonstrates how the ANVS implements the 'Plan, Do, Check, Act' (PDCA) principle.
The AIM-document has not been designed to achieve some kind of certification. Nevertheless it has been based on the components that should be present according to common management system standards.

The AIM-document is an ANVS-internal document. However, various documents have been published to inform the public of the ANVS's policy and procedures regarding licensing, supervision and enforcement. Refer to section 20.1.j for such information.

The AIM document also gives a high-level description of the processes by which the ANVS executes its various tasks. There are three main types of processes: (1) Corporate processes that drive the organisation, (2) Primary processes, the end-to-end processes across the operational areas, for execution of the ANVS' statutory tasks, and (3) Supporting processes for activities that create the prerequisites (staff, other resources) for executing the primary processes. These three sets of processes in the AIM terminology constitute the 'ANVS proceshuis' (literally: process building).
These processes and their detailed descriptions are available to ANVS staff via its Intranet, in a system called 'ANVS Central'. Clickable links give access to all available information.

For every process, roles and responsibilities have been defined. In addition it is described how the various roles contribute to continuous improvement of the processes of ANVS. The periodic invitation of IRRS missions is also part of the efforts to have continuous improvement.

70 RIVM is the Dutch 'National Institute for Public Health and the Environment', GRS is the German 'Gesellschaft für Anlagen und Reaktorsicherheit' and NRG is the Dutch 'Nuclear Research and consultancy Group'.

71 AIM, Dutch acronym for 'ANVS Integraal Managementsysteem'. The resources at the RB currently are adequate, in terms of Human Resources (number of staff and expertise) and financing.

20.1.j Openness 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, which is currently a group of 6 FTE. This is a positive development and aids 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, on Management of radioactive waste and spent fuel and on radiation protection).

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 regulatory body, licence holder and the public. The ANVS aims to be 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.

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. In
2015 and 2016 the basic communication tools (e.g. website, intranet) have been developed further and are continuously improved. Relations with national, regional and local stakeholders and press are gradually built. Special arrangements are in place for the communication and reporting of incidents in neighbouring countries.

Parliament is actively informed by the Minister of Infrastructure and Water Management, supported by the ANVS when relevant. Examples are results of IAEA mission reports, National Reports for the Joint Convention, National Reports of Action plans related to the stress test et cetera. Usually twice a year, the Minister sends a letter to the parliament with a general update on all important issues. The ANVS reports about its annual plan and the status of planned actions.

Currently, lots of regulatory information and products are published on a regular basis, mostly on the ANVS website. Examples are:
- ANVS licences;
- Information on national policies and regulatory framework in the Netherlands;
- ANVS regulations;
- General information about ANVS' tasks and activities;
- ANVS Annual Report;
- ANVS' main policy document, the 'Koersdocument' describing the 'course' of the ANVS, its mission, values, guiding principles, vision on developments, and its choices;
- ANVS policy document on its licensing strategy;
- ANVS policy document on its supervision and enforcement strategy;
- Guidance for applicants on how to apply for a licence, including guidance on what kind of information to include;
- Several review and assessment reports (PSR, licence applications);
- Information about cross inspections with FANC (not the reports);
- Event reports and follow-up;
- ANVS quarterly news items and articles;
- IAEA mission reports.

It is part of the external communication strategy of the ANVS to demonstration its active participations in the international public communication and transparency groups, e.g. ENSREG WGTA and OECD/NEA/WGPC.

20.1.k External Technical Support

The ANVS can rely on various national and foreign organisations that regularly provide technical support. In this section the most important of these are introduced. The ANVS will continue to cooperate with foreign Technical Support Organisations (TSOs) to evaluate safety cases of Dutch licence holders.

Governmental supporting organisation RIVM
Via the ANVS an annual contribution is provided to support the work of the National Institute for Public Health and the Environment (RIVM). RIVM provides scientific support to several ministries including the Ministry of Infrastructure and Water Management but also directly to the ANVS.

RIVM is a specialised Dutch government agency. Its remit is to keep knowledge up to date, by gathering, generating and integrating knowledge and make it available in the public domain. By performing these tasks RIVM contributes to promoting the health of the population and the environment by providing protection against health risks and environmental damage.

The RIVM supports the Ministries with scientific studies. RIVM works together with other (governmental) expert organisations as the Royal National Meteorological Institute (KNMI) with models for the prediction of the effects of discharges of radioactive material in the air. RIVM also operates the national radiological monitoring network and coordinates the collaborating expert organisations for radiological and public health advise in nuclear crisis situations.

Education and training organisations
The RID/R3 organisation at the Technical University in Delft and the Nuclear Research & consultancy Group (NRG) in Petten and Arnhem provide education and training in nuclear technology and radiation protection to clients from nuclear and non-nuclear businesses and various governmental organisations. Dedicated trainings on various topics are also contracted by the ANVS with other national and foreign supporting organisations. For the education and training in radiation protection a national system exists with several levels of education. The government recognizes training institutes for a specific training of radiation protection. For getting a degree in radiation protection, an exam has to be passed. Registration of coordinating and general coordinating radiation protection experts has been implemented. There are formal requirements to obtain registration certificates for the initial education, for continuing education and for work experience.

Technical Support Organisations (TSO)
GRS, Germany: The ANVS collaborates with a Technical Support Organization (TSO) from Germany, GRS. This is a TSO for the German national regulator and one of the large German TSOs. GRS provides technical support like review and assessment of safety cases (e.g. PALLAS). It also has provided other types of consultancy to the ANVS, like support in the development of regulations and provision of education and training. GRS currently has a major framework contract with the ANVS.

NRG, Netherlands: The Nuclear Research & consultancy Group (NRG) in Petten and Arnhem provides consultancy & educational services to government and industry. The company has implemented 'Chinese Wall' procedures to protect the interests of its various clients and avoid conflicts of interest. NRG currently has framework contracts with the ANVS for consultancy in the areas radiation protection and nuclear safety and support in licensing of applications of ionising radiation. NRG is the operator of the HFR research reactor. In the contracts there are strong requirements dealing with conflict of interest, which will be audited.

Other contracted support organisations
RTD, Netherlands: ANVS has a framework contract for support in licensing of applications of ionising radiation with Dutch firm RTD. RTD is a Dutch acronym for 'Röntgen Technische Dienst', a subsidiary of multinational company Applus+, operating in the testing, inspection and certification sector.

SCK•CEN, Belgium: ANVS has a framework contract with Belgium research institute SCK•CEN for consultancy in the area radiation protection. SCK•CEN operates two research reactors at its site in Mol, Belgium.

20.1.l Advisory Committees

The ANVS has an Advisory Board which has the task of providing the ANVS with solicited and unsolicited advice on matters related to the tasks of the ANVS. Refer to section 20.1.a for more information. It has no role in assessing safety, like standing committees in some other countries.

If needed an advisory committee is formed on an ad hoc basis as required, as happened several times in the past. A committee can be formed for any required issue.

20.2 *Status of the Regulatory Body*

20.2.a Governmental structure

The ANVS originally was tasked with policy development and to draft legislation in the areas of nuclear safety, security and radiation protection. Since 15 May 2020, these tasks have been transferred to the Ministry of Infrastructure and Water Management. The newly formed Unit Nuclear Safety and Radiation Protection of the Directorate-General Environment and International is now responsible for this. The ANVS can be consulted as an advisor.

As described in section 20.1.a, while there are other entities contributing to legislative activities and the supervision of the activities of licence holders, RB staff is 'lent out' by the Ministry of Infrastructure and Water Management to the Board of the ANVS.

The ANVS, by an amendment to the Nuclear Energy Act (ANVS Establishment Act), became an independent administrative authority (Dutch acronym: zbo) in 2017.
The Minister of Infrastructure and Water Management bears ministerial responsibility for the functioning of the ANVS. The ANVS is a zbo and as such an administrative independent body, but the Minister is empowered to:
- Appoint, suspend or dismiss the members (of the board) of the ANVS;
- Decide on the remuneration policy for the members of the ANVS;
- Decide on the budget of the ANVS;
- Ask for any information needed for executing his tasks;
- Approve the management regulations of the ANVS;
- Abrogate decisions of the ANVS if they are in violation with the law;
- Taking the necessary measures if the ANVS is severely neglecting its tasks.

The entities of the RB are mentioned in section 20.1.b 'Entities of the RB'. The various entities have regular meetings on those activities for which they share responsibilities. As mentioned before, there is a cooperation agreement describing the interaction, communication and cooperation between the various entities.

There are examples of differing and shared responsibilities. For instance, the Ministry of Social Affairs and Employment is responsible for worker protection and the Ministry of Health, Welfare and Sport for patient protection. An example of shared responsibility is the cooperation of the ANVS with the Dutch Human Environment and Transport Inspectorate (ILT) of the Ministry of Infrastructure and Water Management, in the monitoring of transports of radioactive materials to verify compliance with applicable regulations. The ANVS focuses on the safety, radiation protection and security aspects, while the ILT focuses on the requirements of modal transport regulations.

20.2.b 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 and Climate Policy is responsible for this subject. The involvement of the ANVS with nuclear power is restricted to nuclear safety and radiation protection and associate issues. 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 ANVS aims to be 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 spent fuel and radioactive waste and for implementing a part of the policy of the Netherlands on the safe management of radioactive waste and spent fuel. As a licence holder, COVRA is subject to regulatory supervision by the RB.

The ANVS has documented decision-making processes. However, the ANVS is a learning organisation and attempts to constantly improve these processes. The reporting arrangements (described below) are instrumental in achieving perception of independence in decision-making.

20.2.c Reporting obligations

The ANVS reports to the Minister of Infrastructure and Water Management about its functioning. The Minister of Infrastructure and Water Management bears ministerial responsibility for the functioning of the ANVS. If information has to be shared with the Parliament this will be done by the Minister. In addition, the ANVS sends its annual report to Parliament. About two times a year the Minister sends a letter to Parliament covering progress on several on-going issues of interest concerning nuclear safety and radiation protection for politics and the general public. In this letter, reference may be made to the ANVS website for further information or announce future ANVS publications. Everything reported in Parliament is immediately available on the government website www.overheid.nl and is therefore available to any interested party. This letter is send by the State Secretary of Infrastructure and Water Management, who manages topics associated with the Nuclear Energy Act.

Also, 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).

The ANVS has extensive files on many issues published on its website, featuring many in-depth studies on issues related to nuclear safety activities. Information on all major licence holders can be found online too, such as licences. This is part of the policy on transparent governance. Also refer to section 20.1.j for information on ‘Openness and transparency of regulatory activities’.

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. Responsibility of the licence holder

21.1 *Prime responsibility for safety*

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

The Netherlands has transposed Directive 2009/71/Euratom as amended by Directive 2014/87/Euratom establishing a Community framework for the nuclear safety of nuclear installations and Directive 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation. Articles of these Directives state that the prime responsibility for safety lies with the licence holder.

In the Ministerial Order from 2017 transposing Directive 2014/87/Euratom the licence holders responsibility for nuclear safety and the obligation for continuous improvement of safety is provided. This includes the requirement to develop an institutional safety policy at the corporate level and pursue continuous improvement. It is further stipulated that the responsibility 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 regulation also contains requirements about transparent communication to the public, by the regulatory body and licence holders. 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 licence holder has to present, among others, a safety case, which shall be assessed by the RB. Once the licence is issued, the licence holder is charged with the prime responsibility for compliance with the licence and licence requirements. Besides this, a number of general requirements apply for licence holders.

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 licence holder needs to 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. Upon transferral of the waste to COVRA, all liabilities, including the responsibility for safety, are transferred to COVRA. For more information, see section B.

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 person or organisation responsible for fissile 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 licenced to manage these materials.

For fissile materials two institutes have been designated by a special decree[72]: NRG 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. Human and financial resources

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 licence holder 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 guidelines have been formulated on the subject of attracting and developing (new) employees. In addition to the Personnel Qualification Plan, COVRA has an education plan and education matrix which contains the requisite level of expertise, and in which 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 RB. Together with the job descriptions, which detail the responsibilities and authority interfaces, the Personnel Qualification Plan and the education plan constitute the building blocks to ensure qualified staff.

22 (ii) *Adequate financial resources*

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

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[72] 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.

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 their waste generation. This principle is fulfilled by the fact that COVRA includes in its charges all estimated costs for research, processing, storage and geological disposal, based on state-of-the-art techniques at this given time. Moreover, the main producers of nuclear waste generally directly pay for the construction costs of the buildings in which the waste is stored, these construction costs are not included in the waste management tariffs. This applies for example to the HABOG and VOG-2 buildings.

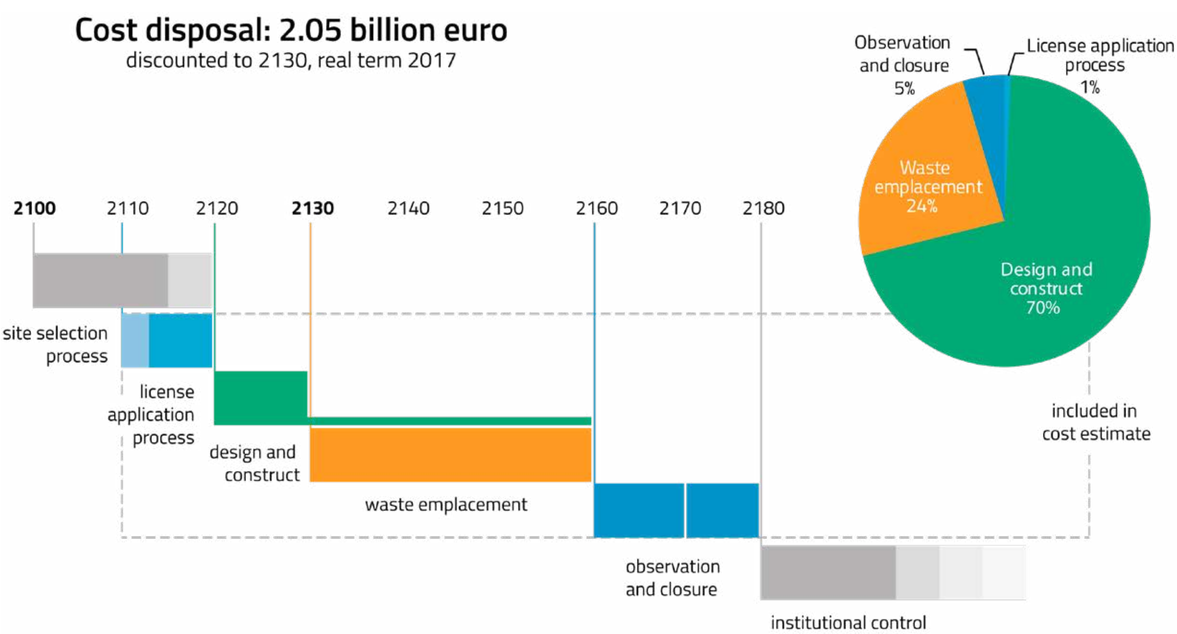
Current arrangements
COVRA charges a (contractual) tariff for all phases of the management involved (including the operational costs for storage and disposal). With the implementation of Directive 2011/70/Euratom, the obligation to add a surcharge to the tariffs of COVRA for future research of disposal has been introduced. The final goal is to acquire the financial resources and knowledge needed to have an operational geological disposal facility 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 geological disposal facility. The cost of management can be roughly subdivided into storage costs and the costs of disposal.

The cost of the above-ground management of radioactive waste at COVRA is estimated at this moment at approx. €13 million per year (excluding transport and processing costs).

COVRA is currently working on the basis of a cost estimate for geological disposal of €2,05 billion (price level 2017, sources: COVRA 2019 annual report and OPERA Safety Case report). The cost estimate is based on a definitive decision on the disposal method being made around 2100. The development of the disposal concept and the site selection process are not included in the cost estimate. The provision for geological 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 the target amount.

Figure 6: OPERA Safety Case: estimated costs of geological disposal in Boom Clay



Based on the 'polluter pays' principle, COVRA passes on the estimated costs for interim storage and geological disposal in the tariffs it charges the waste suppliers. After payment of the tariffs, the financial liability for the waste is transferred to COVRA. The accumulated funds are projected to grow during the period of interim storage, to cover the costs of both storage and 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 interim 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 storage 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. The cost prices are periodically recalibrated to reflect current costs and quantities. These tariffs are corrected annually by the price index of 2%, or 17.5% when a margin on a waste stream is negative.

22 (iii) Institutional controls

The national research programme on geological disposal '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 geological disposal facility. In OPERA an underground observation phase of ten years is included to facilitate eventual retrieval of waste packages before closure.

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 in the Netherlands, 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 GSR Part 2 "Leadership and Management for Safety". Due to the fact that GS-R-3 has been superseded by GSR Part 2 in 2016, COVRA continues the implementation of the Integrated Management System (IMS) using GRS part 2.

Licence
The IMS of COVRA is part of the operating licence and hence is binding for the licence holder. 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 "IMS Blueprint". The blueprint describes the structure and the organizational framework of the COVRA Integrated Management System. The Integrated Management System is process-based and is divided in 4 components:
- Policies (Why);
- Processes (How)
- SSC's (Structures, Systems and Components (With what)
- Organization (Who).

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 NPP's 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. Operational radiation protection

24.1 (i) ALARA

As has been stated before (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 Decree on Basic Safety Standards on Radiation Protection (Bbs).

The Bkse (Article 31) requires the licence holder of a nuclear facility to take adequate measures for the protection of people, animals, plants and property. 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 licence holder must act in accordance with the individual effective dose limits.

The Bbs states that activities and actions involving ionising radiation must be carried out by or under the responsibility of a radiation protection expert, who shall be registered, based on the level of radiation protection education, work experience and (in-service) training 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. Daily work has to be supervised by a radiation protection officer with an adequate level of radiation protection training which includes knowledge on the specific application.

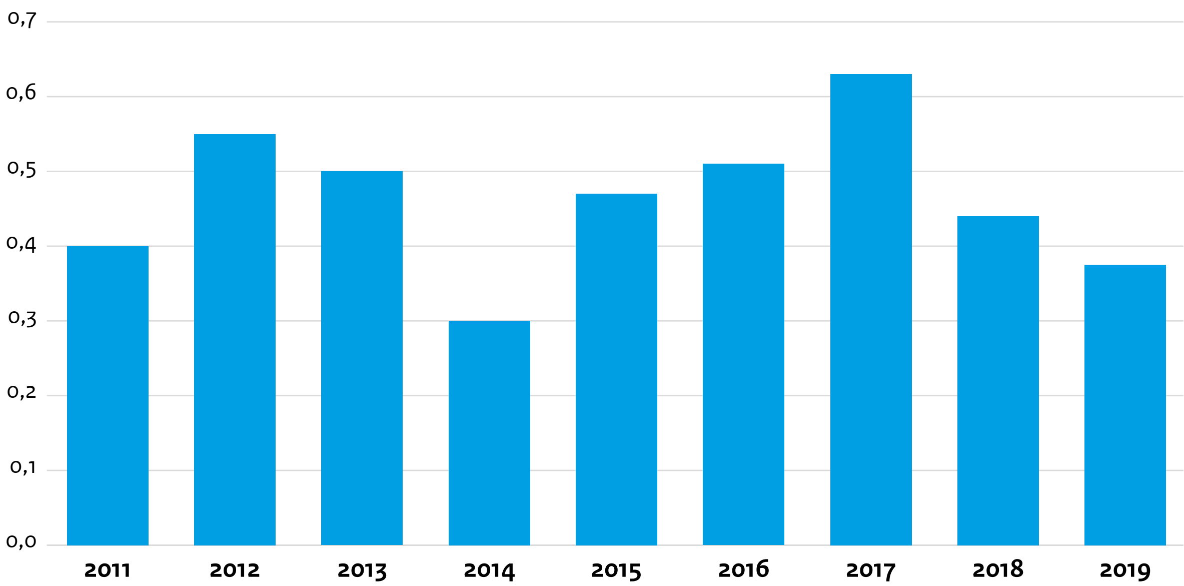
Written procedures must be available to ensure that the radiological protection measures which have to be taken are effective and that the hereinabove mentioned expert is properly informed. Full details of these conditions are given in the Bbs, which includes also more specific requirements on the protection of people and the environment from radiation.

The concept of ALARA is a fundamental principle of the Bbs and it is required to be applied to all exposures and discharges as well as to disposal of radioactive waste. General requirements to optimize exposures are incorporated in the Bbs, in which the application of dose constraints is included. Dose constraints are defined in the different chapters of the Bbs.

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

COVRA continuously applies ALARA in its activities. This starts with the classification of waste in the categories low- and intermediate-level and high-level radioactive waste. This classification is based on the dose rate on contact of the conditioned waste. As a result, radioactive waste with a high dose rate (> 10 mSv/hour on contact of the conditioned waste) is stored in the HABOG. This building is designed in such a way that handling can be done remotely so that no or only a very low dose is incurred during processing and storage. Depending on the dose rate, for low- and intermediate-level radioactive waste extra shielding is applied during transport and buffer storage and, where necessary, remote control of the processes is carried out. This is the case for the immobilisation of liquid waste from the molybdenum production for example. In addition, the presence of people when working with relatively higher radiation waste is kept to a minimum. COVRA has imposed itself a dose constraint of 6 mSv/year per exposed worker (legal limit is 20 mSv/year). With maximum values of 3 mSv/year per individual and an average of 0.5 mSv/year per exposed worker, COVRA manages to keep the received dose as low as reasonably achievable (Figure 7, below).

Figure 7: Average dose (mSv/year) per exposed employee at COVRA



24.1 (ii) Dose limits

Protection of the workers

In conformity with the Euratom Basic Safety Standards the aforementioned Decree on Basic Safety Standard on Radiation Protection (Bbs) 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 identification 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 radiation workers (6 mSv per year for whole body exposure), based on risk inventarisation and evaluation (RI&E). Category B workers are likely to be exposed during their work to radiation greater than the dose limit for non-radiation workers (1 mSv per year for whole body exposure), but less than 6 mSv per year.

The Bbs 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 has as main objective to retain 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 outside workers from abroad whose data are typically identified through the radiation passport.
Accordingly to the Euratom Basic Safety Standards, Dutch legislation requires a licence holder who hires an outside worker to respect the annual dose limit of 20 mSv for A workers and the annual dose constraint 6 mSv for B workers. If necessary, the licence holder and the employer of the external worker cooperate to ensure that the system of individual radiological monitoring affords outside workers equivalent protection to that for exposed workers employed by the licence holder. The ANVS is responsible for surveillance of the radiation protection of workers at licence holders. The ANVS is responsible for surveillance of the radiation protection of workers at licence holders. There are no special ALARA review programmes for workers expected to exceed the 6 mSv dose constraint. However, some licence holders have the policy not to hire workers with more than 10 mSv (in one calendar year) in their radiological passport. In practice, the number of workers with a dose higher than 5 mSv (in one calendar year) 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 licence holder 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 2019 the highest individual dose recorded for the 75 radiation workers (48 COVRA and 27 external) was 2.55 mSv. The collective dose for these persons was about 28 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 (within facility perimeter), the buildings and the working spaces are divided in three coloured-marked zones according to the scheme in Table 6 (below). 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 contamination does occur, 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 respectively the supervised and controlled areas. These zones are located exclusively within buildings and are only accessible the authorization 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 included in written instructions.

Table 6 Operational zones used to control individual exposures

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

Protection of the public

In the Bbs 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 licence holder 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 licence holder 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), and 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 2019 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 licence holder (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 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 (in the order of up to 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 falls 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 falls 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 and spent fuel (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 7 (below) 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[73], as demonstrated in the diagram in Figure 8 and Figure 9. Tritium is released during the conditioning of radioactive waste in the AVG and the emitted amount depends on the amount of tritium in the waste supplied in a specific year.

Table 7 Authorized discharges at COVRA

Category	Annual discharges	
	Air borne[74]	**Liquid**
Alpha	1 MBq	80 MBq
Beta/gamma	50 GBq	200 GBq
Tritium/C-14	1 TBq	2 TBq

[73] In total, discharges may not exceed 1.5 times the above annual limits for three consecutive calendar years. For the sake of caution, COVRA uses only half of the mentioned values in the figures as the limit per year.
[74] 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 8: Emissions of radionuclides to the air from the AVG as a percentage of the annual limit (source COVRA)

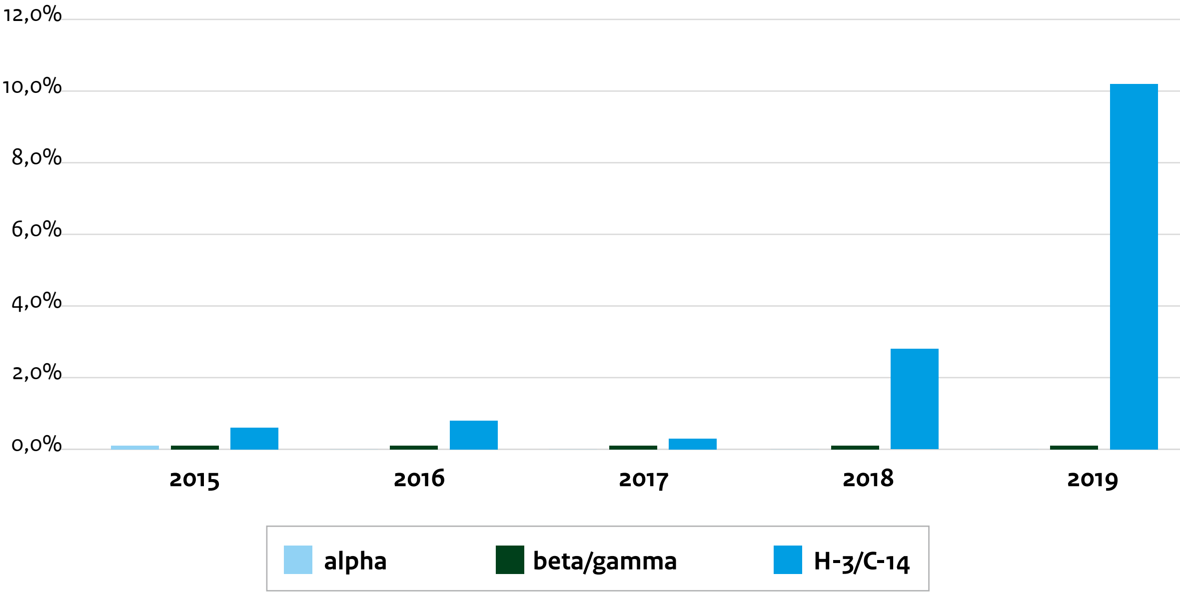
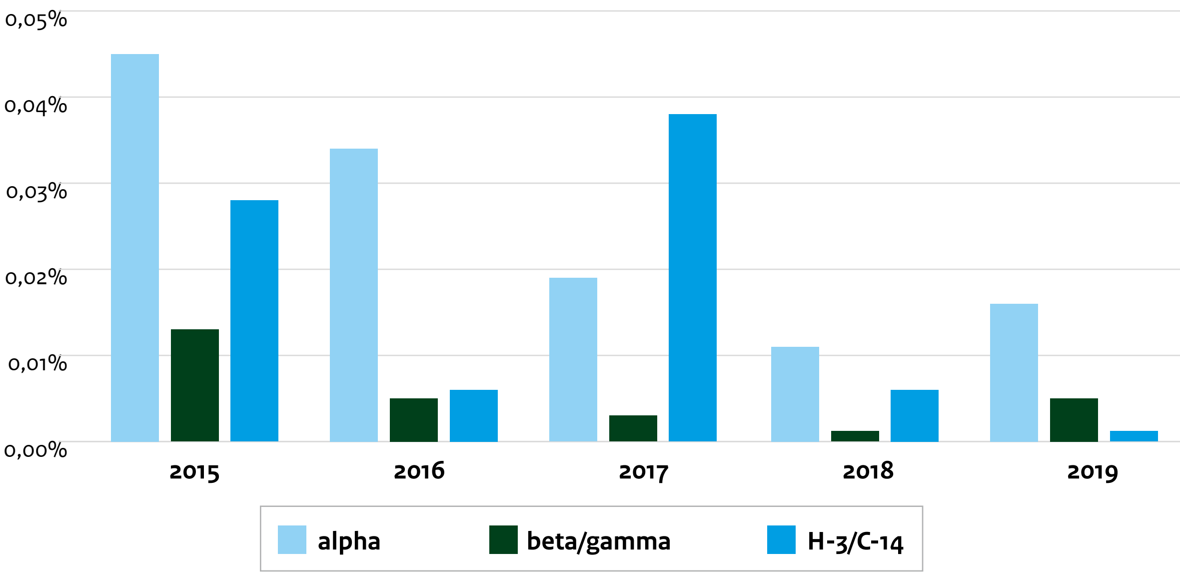


Figure 9: Emissions of radionuclides to water as a percentage of the annual limit (source COVRA)



24.3 *Unplanned or uncontrolled releases*

On-site emergency response plans of a nuclear facility describe the actions that should be taken during 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 Dutch Nuclear Energy Act (Kew) sets the framework for nuclear safety management. It allocates the Regulatory Body's responsibilities for preparedness and response for a nuclear and radiological emergency. In 2017, the transposition of the amended European Nuclear Safety Directive resulted in a new Nuclear Safety Regulation for Nuclear Facilities. In its Article 14, it lists requirements to provisions in the event of accidents. This regulation also makes reference to the Decree on Basic Safety Standards for Radiation Protection (Bbs). The Dutch Security Region Act details the responsibilities for emergency situations in general.

The Bbs requires that licence holder make arrangements in preparing for interventions in case of a radiological emergency on-site. The licence holder has to prepare an emergency plan for each location, which has to be practiced frequently. This general requirement is applicable for nuclear installations and sources. Based on a graded approach approximately 100 licence holders with licences for the use of Category 1, 2 and 3 sources[75] have to have a specific emergency plan for radiological emergencies. The elements that must be addressed in these emergency plans are mentioned in Annex 6 of the Bbs. This annex is a 1-on-1 implementation of annex XI of the European Basic Safety Standard.

25.1.a On-site emergency provisions

The licences for operation of spent fuel and radioactive waste management facilities stipulate that an on-site emergency plan should be established and maintained. In the following, the situation of the facilities of COVRA is 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.

[75] IAEA Safety Guide No. RS-G-1.9.

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 reactor 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 for Radiation incidents: the NCS (Dutch: 'Nationaal Crisisplan Stralingsincidenten') and the 'Response Plan NCS'. These plans describe 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.

The NCS Response Plan describes, among other things, the types of nuclear and radiological accidents and the response processes.

For accidents 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). The Security Region has to be involved in preparing the emergency planning (this is a licence requirement).
For accidents with category B-objects, the chairperson of the Security Region or the mayor of the municipality, depending on the scope of the accident, is responsible for the emergency response. With this type of accident, local authorities can on request be advised by the national nuclear assessment team, the CETsn[76]. An accident with a B-object can also be scaled up as an accident with an A-object. The national authority will then be responsible for decision-making.

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 of accidents at waste management facilities or at waste management departments of other nuclear facilities are likely to be limited. For example, the safety assessments of the different treatment and storage

76 Dutch: 'Crisis Expert Team – straling', CETsn.

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 licence holders emergency plan and organisation and the emergency organisation of the authorities. National full scale exercises have been held in 2005, 2011 and 2018. In the 2018 exercise the scenario was an emergency situation focussed on the spent fuel basin at the NPP Borssele.

Dose criteria and measures

In 2018 a reference level for emergency exposure situations was introduced as an implementation of the European Basic Safety Standards. The level was set to 100 mSv as an acute dose or annual dose. For purposes of emergency planning and response, the intervention levels and measures of Table 8 (below) 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.

Table 8 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 neighbouring country, the Netherlands will initially follow the protective actions of the country where the accident took place. 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 matched with that of the neigboring countries. Furthermore, a range of intervention levels has been introduced. The default value within this range 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 neighbouring country, intervention levels within the range can be used to link with the neighbouring country. Also refer to Table 9 in section 25.1.

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;

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

26 Decommissioning

Table 9 (below) shows which nuclear facilities in the Netherlands are in operation and which have permanently been shut down, awaiting decommissioning and which were recently decommissioned.

Table 9 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}	Decommissioned	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 is the only nuclear facilities presently in a state of decommissioning. The Dodewaard NPP was shut down in 1997 after 28 years of operation. It is now in Safe Enclosure. The LFR was shut down in 2010 and decommissioning was completed in 2019.

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[77]. 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'. According to Dutch legislation this implies also removal of the buildings. Therefore, during the operational phase, the licence holder 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 updated every five years, and shall be approved by the ANVS. The final decommissioning plan eventually becomes part of the decommissioning licence.

During decommissioning, the licence holder is required to store records of the decommissioning process, the release of material, and the release of the site. At the end of decommissioning, the licence holder 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 licence holder to make adequate financial resources available for decommissioning at the moment that these are required. Therefore, the licence holder will have to calculate the total costs of decommissioning (including the costs of all the activities described in the decommissioning plan), and provide for a financial provision offering sufficient covering at the envisaged start of decommissioning or in the event of unexpected closure of business[78]. The licence holder is free to choose the form of the financial provision: however, it has to be approved by the Minister of Finance and the Minister of Infrastructure and Water Management.

LFR

In December 2014 a licence was granted to NRG, the operator of the Low Flux Reactor, to shut down and dismantle the reactor. The reactor already stopped operating in 2010. One of the requirements in the licence was to submit a more detailed dismantling plan for the reactor. This document was reviewed and approved in stages, each time allowing the licence holder to continue dismantling to the approved stage. The licence allowed certain flexibility in the order of dismantling steps. Whenever the licence holder had reasons to change the order of dismantling steps, a notification to the regulatory body was sufficient.

The actual dismantling activities started in 2016 and ended in 2019. During this period the reactor and the building have been dismantled and all waste, both conventional as radioactive, has been disposed of. Also, the terrain received clearance.

In total 327 tonnes of radioactive waste has been removed. This is 100 tonnes less than expected during preparation. The largest contribution to this reduction is the separation of the activated part of the concrete foundation from the part that had been cleared. Due to early contact with a chemical lab and other stakeholders in the removal of the radioactive waste from the site, no unforeseen issues have occurred during the project.

Dodewaard NPP

In May 2002 a licence was granted to GKN, the operator of the Dodewaard NPP, to bring and keep the plant in a state of Safe Enclosure for a maximum of 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 at the latest. 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 licence is that the licence holder shall commence dismantling after 40 years. The licence holder will have to apply for a dismantling licence in due time.

Borssele NPP

The nuclear power station in Borssele is scheduled to end operations at the end of 2033. Based on the legislation, the first phase of decommissioning should start immediately after shutdown in 2034.

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77 The NPP Dodewaard, brought into state of safe enclosure in 2005, is excluded from this requirement of immediate dismantling based on historical grounds and the fact that the plant was already shut down and in safe enclosure when this requirement came in force.

78 In case of accidents the Dutch act on the liability for nuclear accidents applies.

Other nuclear facilities
For the other nuclear facilities, there is no concrete date for shutdown and start of the decommissioning.

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

Financial resources
There has been a general understanding that the "polluter pays principle" applies to all stages of waste management. Consequently, the operators of the NPP's have made financial assurance for decommissioning. The decommissioning funds are managed by the licence holders.

Licence holders of the NPP and RRs are required to have financial assurance 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 licence holder is in principle free to choose the form of the financial assurance. Upon approval, the authorities will assess whether the financial assurance 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 the decommissioning of nuclear facilities. In the specific case of the Dodewaard NPP, liquid emissions of radioactive material are not permitted, while airborne[80] emissions of radioactivity will (per year) be restricted.

Table 10 Release limits of the NPP Dodewaard (in Safe Enclosure)

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

In practice, releases of aerosols and tritium (see Table 10 above) are less than 1% of their limits. In January 2011, a licence change removed the obligation to measure the release of carbon-14, since there's no new carbon-14 created. The actual releases of carbon-14 had been less than 1% of their limit the previous years.

Radioactive waste management Dodewaard NPP
COVRA is responsible for the treatment and interim storage of all kinds of radioactive waste. This comprises also the waste associated with the dismantling of a nuclear facility.

79 Predisposal Management of Radioactive Waste, including Decommissioning, IAEA Safety Series No. WS-R-2, IAEA, Vienna, 2000.
80 No liquid discharges are allowed during the safe enclosure period.

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[81]. Waste quantities will be recorded and the records will be kept at least during the full 'safe enclosure' 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 licence holder 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 province-controlled archive.

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

In the case of the Borssele NPP, preservation of knowledge is less complicated, as the NPP will be dismantled directly after shut down. This is also true for the RRs.

Furthermore, Dutch legislation requires that the operator keeps records and documentation during operation.

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

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 General safety requirements

4 (i) *Criticality and removal of residual heat*

Management of spent fuel originating from Dutch reactors occurs at several different locations (in the Netherlands and abroad):
a. At the site of the nuclear power station in Borssele;
b. At the sites of the research reactors in Petten and Delft;
c. In the interim storage facility for High-Level Waste of the Central Organisation for Radioactive Waste (COVRA) in Nieuwdorp;
d. At the sites of the reprocessing plant in la Hague, France.

Ad a) The Netherlands has a (485 MW_e net power) pressurized water reactor in Borssele, which is in operation. The design of the NPP's spent fuel 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 NPP's'. The design ensures the removal of residual heat from the spent fuel, 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. The 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 spent fuel of the HFR reactor was stored, followed in 2004 by vitrified waste from reprocessing in France and by spent fuel elements from the HOR. Storage of spent fuel, vitrified waste or other high-level waste in the HABOG takes place at regular intervals.
Currently, extension of the HABOG is taking place. For details of the HABOG design refer to the section on article 7 (i).
Since the (60 MW_e) boiling water reactor in Dodewaard has been shut down in 1997, it has been in a stage of Safe Enclosure. All spent fuel has been removed and transferred to the UK for reprocessing. The last transport of spent fuel from Dodewaard was carried out in April 2003 and the resulting reprocessing waste was returned to the Netherlands in 2010, and stored at COVRA.

Ad d) The spent fuel from Borssele NPP is reprocessed in France. Depending on the reprocessors' operating schedule, some quantity of spent fuel is temporarily stored in the reprocessors' storage pools pending (the start of) reprocessing. The spent fuel of Borssele NPP is then being managed under the prevailing regulatory systems in France. The vitrified waste from reprocessing activities will in due time be returned to the Netherlands and stored in the HABOG facility at COVRA. For more information, see the section on Article 32.1 (ii).

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*

According to Article 10.2 of the Dutch Decree on Basic Safety Standards for Radiation Protection, a licence holder in possession of radioactive material is obliged to minimise the generation of radioactive waste. The licence holder is in principle free to choose its measures to achieve this.

Regarding management of spent fuel, the choice whether or not to reprocess spent fuel is left to the operator. The operators of Borssele NPP 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 relative to the electric output of the nuclear power production 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. Spent fuel from the Borssele NPP is reprocessed. Borssele NPP recycles its plutonium through the use of MOX-fuel[82].

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.

4 (iii) *Interdependencies in spent fuel management*

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

[82] In 2010 a licence application was sent to the ANVS for the introduction of MOX-fuel. The MOX-licence became irrevocable in 2013. The first reload was in 2014.

For spent fuel 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. After spent fuel has been shipped to the reprocessing plant, the spent fuel is allowed to further cool for some five to eight years in pools. Then the fuel is removed and chopped up/shredded into pieces for further processing. Solvents are used to separate uranium, plutonium and fission products. The fission products and other reprocessing residues are conditioned by vitrification in packages that facilitate their long-term storage without significant maintenance or risks for workers and society. The final step will be the geological disposal of the waste. The fuel from the RRs is not reprocessed but is, after the cooling down period directly packed in sealed canisters consistent with maintenance-free storage.

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

Radiation protection of workers

The basis of 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);
- the Decree on Basic Safety Standard on Radiation Protection (Bbs).

The above mentioned decrees are fully in compliance with the Euratom Directive 2013/59/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 licence holder 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 licence holder must act in accordance with the individual effective dose limits. The Bbs states that activities and actions involving ionising radiation must be carried out by or under the responsibility of a radiation protection expert, who shall be registered, based on the level of radiation protection education, work experience and (in-service) training. 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. Daily work has to be supervised by a radiation protection officer with an adequate level of radiation protection training which shall include knowledge on the specific application.

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 Decree on Basic Safety Standards for Radiation Protection (Bbs), 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 Bbs 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 licence holder 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 licence holder 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 section on 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 spent fuel. For details refer to the text in sections 24.1 and 24.2, and the section on Article 19.

4 (v) Biological, chemical and other hazards

Since at the NPP no other activities are being undertaken than transference of fuel assemblies from the reactor core to the storage pool and in a later stage transport from the NPP 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 transport respectively storage casks. These casks are designed to prevent hazards. At COVRA's HLW and spent fuel 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 interim storage. Other hazards, such as flooding, gas cloud explosions, airplane crashes, and terrorist actions, 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 acceptable 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 spent fuel management of the NPP is not to use the full capacity of the storage pools for on-site storage of spent fuel. Regular transports of spent fuel from the NPP to the reprocessing plant, required by a licence condition, are carried out to ensure that the spent fuel inventory in the storage pools is kept as low as reasonably achievable.
For the spent fuel of the research reactors the same approach applies. The clear objective is to limit as far as practicable the amount of spent fuel in the storage pool at the reactor site. Regular transports of spent fuel to the HABOG storage facility 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 section on Art. 4 (iv)).

4 (vii) *Undue burdens on future generations*

The strategy of the government of the Netherlands with respect to spent fuel management is founded on the principle that the generation which is responsible for the arising of a hazardous commodity such as spent fuel ows to provide sustainable solutions for the future.

For spent fuel from the NPP's, the decision has been taken to reprocess spent fuel 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 for long-term safe handling and maintenance-free storage. According to prevailing expert views, the HLW is already in a suitable condition for geological disposal.

Spent fuel 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 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 constantly updated 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 spent fuel. Some spent fuel is kept in short-term storage in the spent fuel pool at the Borssele reactor site, awaiting transport to the reprocessing facility. The management of spent fuel of the Borssele NPP that is sent for reprocessing in France is exercised under the authority of the French government.

The only spent fuel long-term management facility is the HABOG facility, managed by COVRA. This facility is designed to store spent fuel from the research reactors and residues from reprocessing (vitrified waste) and has been commissioned in 2003. An upgrade of the safety of this facility is not applicable yet. Work has started 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 and completion is expected in 2021.

The ministerial decree on nuclear safety of nuclear installations[83] requires continuous improvement of (nuclear) safety and the execution of periodic safety reviews. In line with this, the licence holder 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. COVRA is currently carrying out a periodic safety review.

[83] Dutch: 'Regeling Nucleaire veiligheid kerninstallaties'.

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. Siting of proposed facilities

The text below is also applicable to radioactive waste management facilities (Article 13).

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 section on 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 interim storage of spent fuel and high-level radioactive waste in the Netherlands. The storage pools at the research and nuclear power reactor sites are not intended for long-term interim storage and are consequently not considered in this report.

The site selection procedure for COVRA in Nieuwdorp featured a two-track approach.
The first track started with the establishment of a commission of high-ranking officials from the public domain. The first step in the procedure was the formulation of selection criteria for the site of the COVRA facility. The selection criteria for candidate sites were mainly based on considerations of adequate infrastructure and the location in an industrialised area. Twelve sites were selected by the commission based on these rather general criteria as being suitable in principle. 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 legal procedures for overruling a refusal by a local or regional authority to accept a potentially suitable storage or disposal site, it was deemed better to follow the consensus model for the allocation of a site.

As mentioned above, the second track towards the selection of a site, was an assessment of the possible environmental effects from a spent fuel and waste storage facility for a generic site. The Environmental Impact Statement (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 spent fuel 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 section on 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 section on 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 Design and construction of facilities

7 (i) *Limitation of possible radiological impacts*

Spent fuel from the RRs and reprocessing residues (vitrified waste packages) 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 10 (below).

Figure 10: Cross-section of the HABOG facility

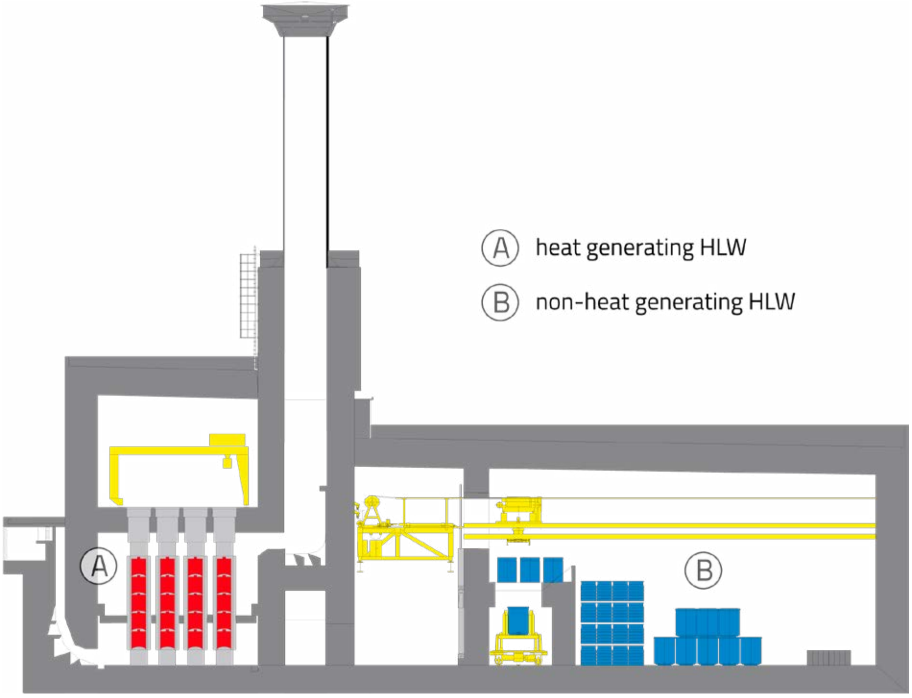
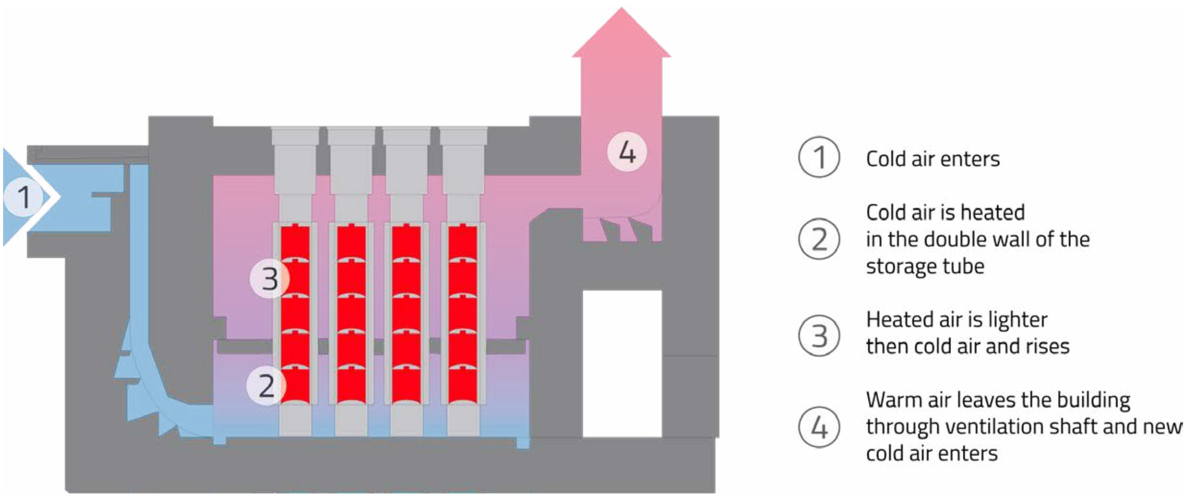


Figure 11: Storage wells for SF and HLW in the HABOG, with passive cooling



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 spent fuel originating from the NPP's, for spent fuel originating from the research reactors and spent uranium targets from molybdenum production. Spent fuel 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 spent fuel, 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 spent fuel and vitrified HLW is represented in Figure 11 (above).

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*
  Spent fuel (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 spent fuel/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 for example flooding, fire, explosions in the facility, earthquakes, hurricanes, gas explosions outside the facility, an aircraft crash, and a drop of a package from a crane. 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 spent fuel, 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 spent fuel/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 spent fuel 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 spent fuel and HLW vaults) under pressure (lower pressure inside the building). 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 spent fuel and waste packages accepted in the building have to be free of (non-fixed) contamination (IAEA Safety Standard SSR-6[84]). The areas in the HABOG which may be contaminated with radioactive

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

material due to handling of spent fuel/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 permanently contaminated. Keeping the buildings clean is an integral part of the operations, which prevents or limits the build-up and spreading of any contamination. By regularly conducting contamination measurements, any contamination is timely detected and removed. Finally, the consequences of any contamination are limited by compartmentalisation.

7 (iii) Technologies incorporated in the design and construction

One of the important features in the design of the HABOG facility is the application of natural convection for the control of the temperature of the spent fuel 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. Similar systems are also being used in Hungary, Belgium and 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 Assessment of safety of facilities

8 (i) Safety assessment

A licence for a spent fuel management facility is only granted if the applicant complies with the national requirements and, more in general, with international (IAEA) established safety goals, codes and guides, as well 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.

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

After construction and commissioning of the spent fuel management facility the licence holder submits the updated 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, the licensing basis for the HABOG building was based on the French state of the art for spent fuel/HLW storage. As an independent assessment tool for the SAR the USA standard ANSI/ANS 57-9-1992 was incorporated.
The SAR was submitted to the RB for approval. Selected items or documents in the SAR are studied more in-depth, often using assessment by independent organizations

8 (ii) *Updated assessments before operation*

In the Environmental Impact Assessment Decree[85], 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 11 (below).

Table 11 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 disposal of irradiated nuclear fuel c. solely for the 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 to prepare 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 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 perimeter 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.

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;

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

(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 Operation of facilities

9 (i) Licence to operate

After the commissioning of the spent fuel/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 received the first batches of spent fuel and HLW, the RB closely followed the safety of the installation by inspections and assessment of the licence holders periodic operation reports.

For the long-term interim 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 culture or risk acceptance.

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

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

9 (ii) Operational limits and conditions

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

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

The development of a management system for maintenance of safety-related installations and components is required by the licence conditions for the operator as specified in the operating licence. COVRA has such a management system in place. Examples of such licence conditions included in the IMS:
- 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 moved into HABOG. During that phase, maintenance and control will continue. In 2130 a geological disposal facility should be operational.
The provisions needed for maintenance during this passive period (as well as for the disposal) has been paid in advance by the waste producer and was calculated as discounted value. The money is transferred to a capital growth fund, managed by COVRA.

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, the operational life of the NPP at Borssele has been extended to 2033, and thus more HLW will be generated. A agreement 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 spent fuel produced after 2015 (for more information, see the section on Article 32.1 (ii)). COVRA has a comprehensive 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 licence holder 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 experience 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. At the end of 2017, the compulsory periodic update of the plan has been approved by the ANVS. 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

The spent fuel that originates from the research reactors will be stored at the HABOG-facility. Geological disposal is foreseen 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 section on 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 Existing facilities and past practices

12 (i) *Safety of facilities*

COVRA

All radioactive waste in the Netherlands (above 10 times the general clearance levels) is treated and stored at one central radioactive waste management facility: COVRA. It consists of an operational waste treatment and waste storage facility for low- and intermediate-level radioactive waste (LILW), the AVG, and a treatment and storage facility for high-level waste (HLW) and spent fuel (SF), the HABOG. On the premises of COVRA a building was also constructed for the storage of NORM-waste (COG), as well as buildings for the storage of depleted uranium oxide (VOG and VOG-2). 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 context 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 prescription to have periodic safety reviews. Refer to the section on Article 5 for details.

WSF

A second and older radioactive waste management facility is located at the research location Petten. This Waste Storage Facility (WSF) is operated by 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 containers. This waste, resulting from four decades of nuclear research at that location, consists 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 (30-35 litre) cylindrical metal containers placed inside concrete-lined pipes, a smaller amount is stored in concrete trenches. This waste is continuously sorted, repackaged and transferred to COVRA.

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 2026. For more information, see the section on Article 12 (ii).

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 effected 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 low- and intermediate-level waste containers 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 highly active mixed waste containers, 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 PVC-filled (or supposedly filled) containers (based on archived information), about 130 in total, were sorted, repacked, and prepared for interim storage at COVRA. The PVC was removed from the highly active waste and repackaged separately as much as possible. 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 2026.

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 - will be paid by the owners of the historical waste. The costs are divided according to the volume ratio of the waste. The management of the historical waste and the transfer of this waste to COVRA is integrated in the licence 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 section on 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 Design and construction of facilities

14 (i) Limitation of possible radiological impacts

In the section on Article 7 a description is given of the building and installations for the handling and storage of spent fuel 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 licence holders 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 immobilised 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 separated by chemical precipitation 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 container with a 1500 tonnes super compactor. The compacted containers are transferred to larger containers and immobilised 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 supplier are mixed with cement and stored in containers. Other radioactive waste consisting of large sized components is first pre-compressed, or shredded or cut to fit the compacting drums. Again conditioning for long-term interim storage is done with cement grout and concrete.

The buildings for the storage of conditioned LILW (LOG) are robust concrete buildings with floors capable of carrying the heavy load of containers 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 containers.

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

In the buildings VOG and VOG-2, 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 section on 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 section on Articles 7 (ii) and 9 (vii).

14 (iii) Closure of disposal facilities

For several decades, retrievability has been included as a precondition in the policy for the management of radioactive waste in a disposal facility. This means that the possibility for retrieving waste (packages) must be included in the design of a facility, such that the retrievability of the waste (via the existing shaft) must be possible during the use of the disposal facility. Research in the past has shown that it is possible to create a retrievable geological disposal facility in clay and salt, for a period of one hundred through to several hundreds of years. Following this period, the radioactive waste can still be retrieved via a new shaft. The costs however are many times higher.
The period of retrievability offers future generations the possibility of retrieving waste from the disposal facility if new techniques for waste processing or management become available. The reversible structuring of the process for (definitive) disposal will also relieve future generations from the burden of decisions taken in the past.

The main reasons for introducing the concept of retrievability were derived from considerations of sustainable development. Waste is considered a non-sustainable commodity and its arising should be prevented or limited. 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 geological disposal, retrievability will make the construction and operation more complex and implies 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 geological disposal facility 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 geological disposal facility 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 disposal facility accessible for retrieval purposes is restricted to a maximum of a couple of hundred years, depending on the type of host rock[86]. 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 geological disposal facility and a facilitation of the heat dissipation to the rock formation. Consequently, the retrieval period should be limited to a realistic length of time. In consultation with society, it will be important to assess the optimum period of retrievability. Under all circumstances, radioactive waste must be retrievable during the operational phase of the disposal facility through to its closure. In the Netherlands only salt and clay are available as possible host rock for a geological disposal facility.

[86] 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).

14 (iv) *Technologies incorporated in the design and construction*

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

Article 15. Assessment of safety of facilities

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

(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;

(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

15 Assessment of safety of facilities

There is no decision yet for the construction of a geological disposal facility. After the period of long-term interim storage, geological disposal is foreseen around 2130. The decision-making in that matter is expected around 2100. For the other entries see the section on 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 Operation of facilities

16 (i) Licence to operate

See section on Article 9 (i).

16 (ii) Operational limits and conditions

See section on Article 9 (ii).

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

See section on Article 9 (iii); there are no plans for the construction of a disposal facility. After the period of long-term interim storage, geological disposal is foreseen around 2130. The decision-making in that matter is expected around 2100.

16 (iv) Engineering and technical support

See section on Article 9 (iv).

16 (v) Characterization and segregation of radioactive waste

For LILW the waste producer provides a completed and signed application form on which the radionuclide content and properties of the waste delivered to COVRA is specified. The form is checked and co-signed by COVRA before any waste is accepted. COVRA segregates the LILW in four categories:
A. Alpha contaminated waste;
B. Beta/gamma contaminated waste from nuclear power plants;
C. Beta/gamma contaminated waste from producers other than nuclear power plants with a half-life longer than 15 years;
D. Beta/gamma contaminated waste from producers other than nuclear power plants with a half-life shorter than 15 years.

During treatment and conditioning, the categories are kept separate.

The price of transference of radioactive waste to COVRA is a financial incentive for licence holders to segregate at the production point as much as possible radioactive and non-radioactive materials. As transference of the waste to COVRA includes transference 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, 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 section on 9 (v).

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

See section on 9 (vi).

16 (viii) *Decommissioning plans*

See section on 9 (vii).

16 (ix) *Closure of a disposal facility*

There are no plans for the construction of a geological disposal facility. After the period of long-term interim storage, geological disposal is foreseen around 2130. The decision-making in that matter is expected around 2100.

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[87] Council Directive nr. 2006/117/Euratom[88]. This directive sets out similar requirements as the ones specified in paragraphs (i)-(v) of article 27 of the Joint Convention.

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 as radioactive waste. However, with a view to the quantities and high radioactivity levels, these shipments are also subject to the provisions of Directive 2006/117/Euratom and need an import and export licence.

In addition to that, for transports inside the Netherlands, depending on the material, a transport licence or transport notification is required based on the Nuclear Energy Act. The transport shall be in compliance with the international transport regulations covering aspects such as transport safety, radiation protection, package design approval certificates and physical protection measures.

Paragraph 2 of article 27 of the Joint Convention 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), RID (rail transport) and ADNR (transport over inland waterways). The provisions in these agreements[89,90,91,92,93] are not affected by the Joint Convention.

[87] Decree on the import, export and transit of radioactive waste and spent fuel, Bulletin of Acts and Decrees, 2009, 168.
[88] 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.
[89] International Civil Aviation Organisation (ICAO), Technical Instructions.
[90] International Maritime Organisation (IMO), International Maritime Dangerous Goods Code.
[91] Accord Européen relatif au Transport de Marchandises Dangereuses (RID).
[92] Règlement International concernant le Transport des Marchandises Dangereuses par Chemins de Fer.
[93] 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 re-entry 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 clearance limits, specified in Annex I of the Euratom Basic Safety Standards[94] and implemented in the national Transport Decree, Basic Safety Standards Radiation Protection Decree (Bbs) and subordinate regulation, must be licenced. A licence will only be granted 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 at a level in accordance 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[95] 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 licenced, that it is uniquely identified with a number embossed or stamped on the source and that countries keep a registry of all licence holders and sources. It further provides for financial arrangements to ensure that the costs for management of disused sources are covered by the licence holder. In cases where no owner can be identified, the State will cover the costs. The provisions of this Directive are fully implemented in the Basic Safety Standards Radiation Protection Decree (Bbs) and subordinate regulation. After Council Directive 2013/59/Euratom was implemented (February 2018), the transport of HASS is subject to licensing.

In articles 22 and 33 of the Nuclear Energy Act a mechanism is put in place in which recovered 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 legislation and regulations regarding sealed sources. Their scope covers safety and security aspects.

94 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.

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

Registering, monitoring and detection of sources

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 licence holder, 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[96]. 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 specifically. 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.

Detected orphan HASS

In late 2018 and early 2019, on four separate occasions, potentially dangerous HASS containing Co-60 were found in scrap metal originating from Africa, purchased on the international scrap metal market: on 13 November 2018, 28 January 2019 and 7 March 2019 in the Netherlands and on 11 January 2019 in Germany. All four events were reported to the IAEA. The radioactive sources were not shielded. In the Netherlands no dose limits have been exceeded for members of the population or workers during the presence and recovery of the dangerous radioactive sources.

Analysis of the discovered radioactive sources suggests that the radioactive sources probably originate from industrial gauges and/or a research irradiator, self-contained irradiator or panoramic irradiator (possibly from a source rack). Despite ongoing analysis, the original application has not yet been determined. It remains possible that more radioactive sources are out of regulatory control. It is likely that the country that shipped the scrap metal containing the discovered radioactive sources is not the country of its original provenance.

Close international collaboration between the IAEA, the Netherlands, Germany and country of shipment, both by the regulatory bodies as well as by the ambassadors, has resulted in an IAEA Fact Finding Mission to the latter country. Several points of improvement have been identified. Since the detection on March 7, 2019, no new detections of similar dangerous radioactive sources have been reported. Radioactivity in metal scrap occurs rather frequently and the scrap, in many cases only the contaminated part, is transferred (if needed after treatment) to COVRA for interim storage on a routine basis.

Waste management of disused sources

With respect to disused sources the regulation and policy give 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 licenced waste treatment or storage facility, is considered to be the final alternative. The licence holder is allowed to store radioactive waste onto its premises for the period of 2 years after cessation of the use. Within this period, the radioactive waste must be transferred to COVRA.

Sources, as any other radioactive waste, are destined for disposal in an geological disposal facility 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[97] 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 are regulated by Council Regulation (Euratom) No 1493/93 of 8 June 1993 on shipments of radioactive substances between Member States.

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96 Decree on the detection of scrap material contaminated with radioactivity, Bulletin of Acts and Decrees 2002, 407.

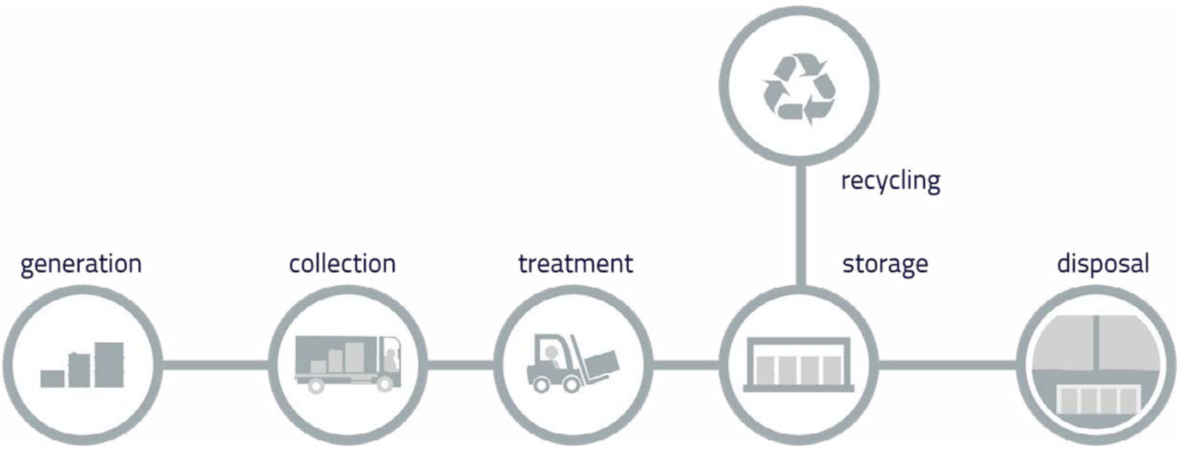
97 Directive Nr. 2006/117/Euratom of the Council of the European Communities of 20 November 2006 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community.

Section K General Efforts to Improve Safety

Knowledge management

The process towards the realisation of a geological disposal facility stretches over several generations. In that process, it is essential that the knowledge of radioactive waste management is assured at all responsible parties in the process. This is a multifaceted issue (see Figure 12 below).

Figure 12: 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 interim storage, COVRA is responsible for the administration of and assuring the knowledge relating to the waste stored at the location. This is not only important for the future when the waste is transferred to the disposal facility, but is also an important aspect of safe day-to-day operations. Based on the properties of the waste (e.g. the type and history of the stored materials, the chemical structure, the activity and nuclide composition and the amount of radiation being emitted by the waste, but also about the conditioning and packaging methods), it is possible for future generations 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 programs on the safe disposal of radioactive waste have already been running for decades in the Netherlands.

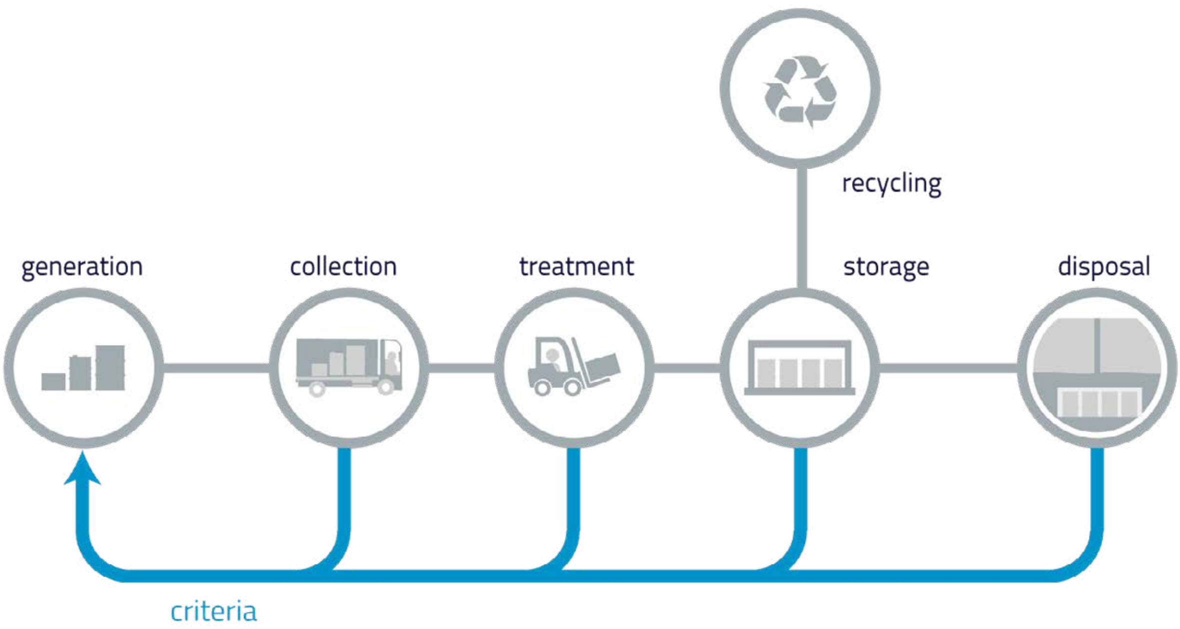
- *(Transfer of) Knowledge*
  Maintenance of knowledge of the properties of the waste and the disposal facility(ies) is necessary to inform future generations of what will be located in geological disposal facilities, where and why. In (international) research programmes into disposal, much attention 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 on the surface till 2130, this also allows time to learn from experiences abroad.

Maintenance of nuclear competence

Maintenance of nuclear competence at COVRA

Since Dutch radioactive waste policy is based on the concept of long-term interim storage, it is a challenge to maintain nuclear competence at COVRA for a period of at least 100 years. As COVRA is the only organisation in the Netherlands licenced 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 interim storage period. Additional expertise could be hired from support organisations in the Netherlands and abroad.

Figure 13: Knowledge on the various steps of the radioactive waste management chain needs to be preserved



The processing of radioactive waste requires specialist knowledge. Knowledge that is required to take into account the requirements of activities that will be made far into the future during collection and processing. The preservation of information on the stored waste and its history is ensured by technical means: all data are preserved in a double archive, using both digital as well as conventional paper data storage. A distinction is made between the short-term archives (<15 years) and the long-term archives (>15 years). For the long-term archive additional measures are taken. The digital information is stored in two different buildings and a procedure exists to update this information at regular intervals. Paper information carriers are printed on certified durable paper and ink and stored in a conditioned room.

There has been a lot of international developments in the field of geological disposal and much progress is expected due to the expected development of the first disposal facilities for high-level radioactive waste in the coming years. COVRA has attracted new staff to be able to maintain its knowledge on disposal at a sufficient level and plans to start a long-term research programme on geological disposal in 2020 based on international cooperation.

Maintenance of nuclear competence at the Regulatory Body

To fulfil its tasks, the RB needs to comprise of adequate numbers of suitably qualified and experienced staff. Not all knowledge and competences can be available within the RB, so the RB has contracts with TSOs and research institutes to have access to specialized experts. Recently the RB staffing has been enlarged. Furthermore the staff receives dedicated training. The establishment of the ANVS - uniting various entities constituting the present RB, with guaranties for its robustness - will aid further to the competence at the RB.

To ensure that sufficient knowledge remains available at the ANVS in an environment in which nuclear activities in Europe are being phased out, the Advisory Board of the ANVS recommended to promote a national nuclear knowledge management programme in the Netherlands in co-operation with relevant stakeholders. Refer to 20.1.a for more information on the follow-up of this recommendation. In the advice of the Board on the role of the ANVS around disposal, the Board states that ANVS should have the knowledge and expertise to (among others) perform safety evaluations of a disposal facility and recommends to strengthen the associated necessary knowledge. In 2020, the ANVS started a knowledge development programme which will contain the development of knowledge on disposal.

Suggestions and Challenges identified at previous Review Meetings

For more information on the measures taken to address suggestions and challenges identified at the previous Review Meeting, see section A.

International peer review missions

The Netherlands hosted various international missions at its nuclear facilities. Refer to the national report for the Convention on Nuclear Safety[98] and especially its Appendix 7 'Missions to Nuclear Installations and the RB' for more details.

The Netherlands hosted an IRRS mission in November 2014 and an IRRS follow-up mission in 2018. For more information, see Section A and Annex 5.

An ARTEMIS[99] mission and the next IRRS-mission are planned for 2023.

Results of international peer review missions are made available to the public. Experts of the ANVS participate and contribute to IAEA missions in other countries.

Actions taken to enhance openness and transparency

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 20.1.j 'Independence of regulatory functions'. The Joint Convention report is available for the public.

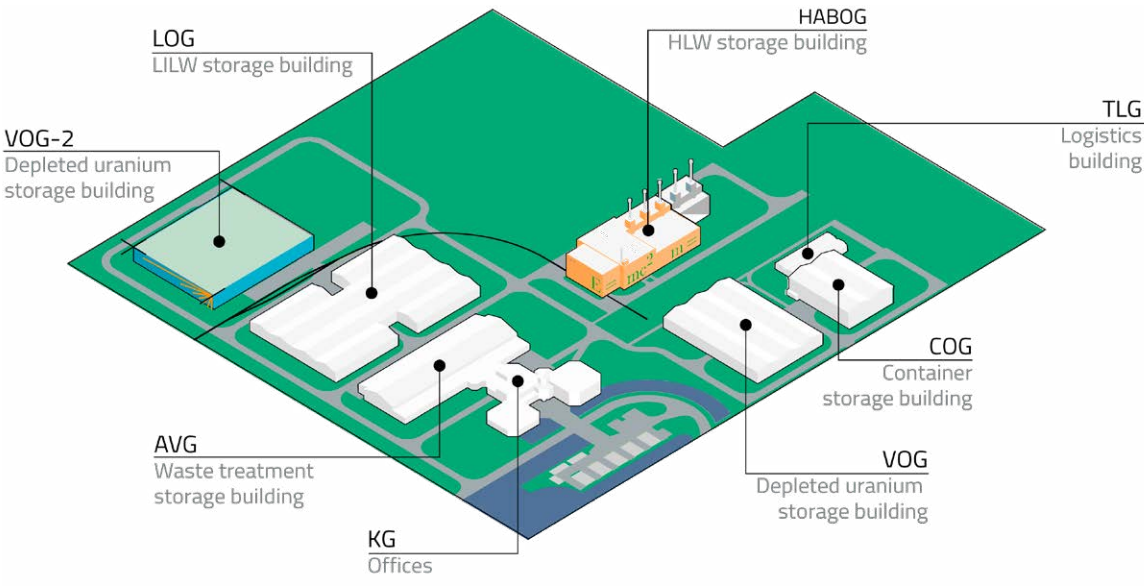
98 Published in 2019.
99 ARTEMIS is an integrated review service for radioactive waste and spent fuel management, decommissioning and remediation programmes, developed by the IAEA.

Section L Annexes

Annex 1. Interim Waste Storage Facilities

COVRA has a site of about 25 ha at the industrial area Vlissingen-Oost. Long-term interim storage was taken into account in the design of the facilities, installations and packages. The available site offers enough space for the waste expected to be produced in the Netherlands in the next hundred years up to disposal. A layout of the COVRA facilities as present today, is given in Figure 14.

Figure 14: Layout of the COVRA facilities



Buildings

All storage facilities are modular buildings. 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 buildings.

The storage building for low- and intermediate-level waste (LOG) is H-shaped and 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 20-ft containers, including decay storage (for a maximum of 50 years) and NORM[100]-waste (COG), which can be modularly extended to triple its current size in the future.

The storage building for depleted uranium is the VOG. A second building for the storage of depleted uranium (VOG-2) has been constructed to accommodate the generation of the depleted uranium from 2017 on.

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

Low- and intermediate-level waste in the LOG

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:

[100] Naturally Occurring Radioactive Material, NORM.

- Provide a 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 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 package 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 15: The storage of low- and intermediate-level waste in the LOG

Figure 16: The storage of 20-ft containers in the COG

The conditioned waste packages are stored in a dedicated storage building (LOG). Simplicity, but robustness was leading in the design phase. 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 15 above). 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 firefighting 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.

Decay storage and NORM-waste in the COG

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.

There are forms of radioactive waste that require several tens of years to decay to below the release threshold values. Some of this material is potentially valuable, such as metals or rare earth elements, that could be reused. Decay storage makes it possible to return valuable (raw) materials that are no longer radioactive to the raw material cycle. Bulk material that is slightly activated or contaminated and decays below the exemption limit within a period of 50 years is eligible for decay storage in COG as well.

Economics played an important role in the implementation of the storage solution. The waste for decay storage and the calcinate are stored in a 20-ft container. Where needed these containers can be tailored to the characteristics of the waste stored. The container for calcinate has three filling positions in the roof of the container that can be closed with a sealed lid and a polyethylene bag that serves as a liner. The inside and outside of the container is preserved with high quality paint. The 20-ft containers can be filled with up to 30 tonnes of material. These containers are stacked four high in the container storage building (see Figure 16 above). 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 60%. As all containers must be free of outside contamination according to normal transport requirements, no contamination is present inside the building.

Depleted uranium in the VOG

Depleted uranium from enrichment activities, is stored in a similar way as calcinate: storage of unconditioned material in larger containers, in this case storage of U_3O_8 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 future and the decision is taken to dispose of the material, this can be done according to then applicable standards. Funds for this treatment and for disposal are 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 in the HABOG

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 spent fuel 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 during the long-term interim storage period. 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.

The choice for this system that has no mechanical components is a direct result of the choice for long-term interim 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 chance 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. spent fuel 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 Figure 17 (below) for the appearance of HABOG before the current ongoing extension.

Figure 17: HABOG before current extension

The extension of the HABOG is in progress. Currently, approximately 110 m^3 of high-level radioactive waste is stored in the HABOG. The extension will offer 50 m^3 extra storage capacity for heat-producing high-level radioactive waste. See Figure 18 for photos of the construction of the extended HABOG.

Figure 18: Construction on the extension of HABOG. A. heavy reinforcement in the concrete floor on which the wells are placed. B. Pouring concrete for 1,7 m outer walls C. with the emplacement of the ventilationshafts the construction reaches its highest point

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.

HABOG

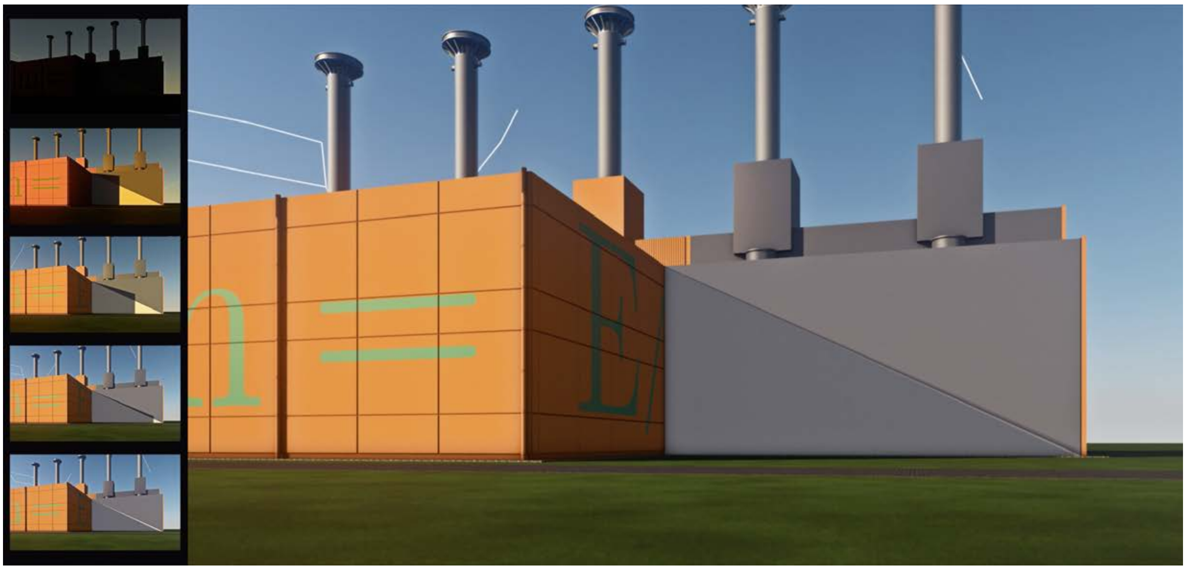
During construction of HABOG - the interim storage building for high-level radioactive waste and spent fuel - the idea was born to take this one step further, to do something really special. Discussions with an artist, William Verstraeten, resulted in a provocative idea. The artist launched the idea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

HABOG features a bright orange exterior and the prominent display of Albert Einstein's equation $E=mc^2$ and Max Planck's $E=h\nu$. Designed to last for up to 300 years, it contains the waste resulting from the reprocessing of the spent nuclear fuel from the 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.

As HABOG is being extended for extra storage space, the artwork also needed to be expanded. The work of art on the extended building has the sun perform a visual play with the building in the same tradition as in Stonehenge or as in the pyramid of Quetzalcoatl in Mexico. In the morning the sun casts its shadow over a side wall of the new extension and the shadow bisects that wall diagonally, symbolizing the half-life of radioactive substances. The color of a shadow depends, among other things, on the reflection and the contrast of colors in the environment and the light intensity of the sun. By choosing the right colors for the two diagonal parts of the new side wall, the play of the shadow will make the wall optically disappear and a flash will arise at the moment of division, just as radiation is released during the decay of radioactive substances. This special effect will be seen twice a year. It looks a bit like the green flash of the setting sun, a rare phenomenon that can be seen in the month of June with the right weather conditions.

Figure 19: Visual play of sun on the extension of HABOG occurring twice a year



LOG

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 interim 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, has a 40-year contract with a storage depot.

VOG-2

The second building for storage of depleted uranium offers further opportunities to interest the public and to start a dialogue. To use the building 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. For us humans, the concept of time is directly related to our sun. Sundials have shown the passage of time as a shadow progresses for many centuries. The storage facility for depleted uranium is a sundial.

Figure 20: Second depleted uranium building: the largest sundial of Europe

Office building

Inside the office building art exhibits are organized four times a year. For example, in 2020 Rem van den Bosch, a renowned photographer in the Netherlands, held an exhibit called #7. The exhibit was based on seven generations philosophy of the Haudenosaunee, Native Americans that believe we have the Earth on loan. With every social decision, they consider what it means for the next seven generations. Project # 7 takes its name from those seven generations. Rem made portraits with the number 7 of about 40 people. Behind every portrait is a story, an idea or a wish for the future. These portraits were exhibited at COVRA in 2020. The choice for COVRA seems special, but it is actually very obvious. After all, reflecting on long-term consequences is also what COVRA does. After all, when managing radioactive waste, you have to think many decades ahead.

Figure 21: two children drawing #7 on the street

7 is more than just an photo exhibit about long-term thinking. It also includes an education project for schools and discussion sessions for companies. Everyone is invited to participate in the project by taking a selfie with the number 7, for example written on your hand. Use # 7 on social media and share your thoughts or ideas about the seven generations philosophy. Together with initiatives large and small, we make a fist for a better world.

International recognition

In the *2009 IAEA waste safety appraisal* of COVRA, the communication policy of COVRA was recognized 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 led 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. In the 2015 Review Meeting of the Joint Convention, the innovative approach in which COVRA communicates with the public, while taking into account the emotions surrounding radioactive waste by incorporating artistic elements in the design of the storage facilities, has been identified as a good practice. In the 2018 Review Meeting of the Joint Convention, the continuation of the existing practice of incorporating artistic elements into the design of the storage facilities at the Central Organization for Radioactive Waste, such as the extension of the high-level radioactive waste building (HABOG) and the new depleted uranium storage building (VOG-2), has been identified as an area of good performance.

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/) an European collaboration initiative for geological disposal.

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 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.

WENRA WGWD

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.

EURAD

The aim of EURAD (https://www.ejp-eurad.eu/) is to implement a joint Strategic Programme of research and knowledge management activities at the European level, bringing together and complementing EU Member State programmes in order to ensure cutting-edge knowledge creation and preservation in view of delivering safe, sustainable and publicly acceptable solutions for the management of radioactive waste across Europe now and in the future.

Annex 4. History of development of the policy and the research programs

Short history of the development of the policy

For more than thirty years the Dutch policy on radioactive waste is based on the interim storage of radioactive waste at COVRA for at least 100 years, after which geological disposal is foreseen.

The basis for the current policy on management of spent fuel 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.

The report from 1984 led to the establishment of the national waste management organisation, the COVRA in Nieuwdorp, and to the launch of a research programme on geological 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 spent fuel and radioactive waste generated in the Netherlands, whereas in the meantime research into the best long-term solution can be done.

In 1993 the government adopted, and presented to parliament, a position paper on the geological disposal of radioactive and other highly toxic wastes. This formed the basis for further development of a national radioactive waste management disposal policy. The new policy required that any 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 the disposal facility is likely to make the construction and operation more complex and costly.

In 2016, the Netherlands published the 'national programme for the management of spent fuel and radioactive waste' which describes the policy regarding the management of spent fuel and radioactive waste now and in the future. The national programme describes (among others) the dual strategy and the national route to disposal.

Short history of the national research programmes into disposal 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.

Notable programmes were:
1976 – 1979, Desktop studies performed by RGD (predecessor of TNO, geological branch) and RCN (predecessor of NRG). A research programme was conducted regarding the geological disposal of radioactive waste 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 geological 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 geological disposal of radioactive waste in rock salt formations.
1995 – 2001 CORA programme. Development and comparison of retrievable geological disposal options, mainly in rock salt and clay.
2011 – 2017 OPERA Programme. Development of an initial Safety Case for the geological disposal of radioactive waste and spent fuel in Boom Clay and road map for future research.

OPLA

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 geological disposal remained low. Progress of the geological 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 geological disposal facility being available within the next few decades was remote.

CORA

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 geological disposal facility 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 geological 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 geological disposal design are required to maintain accessibility. This applies particularly to a geological disposal 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 geological disposal facility, 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 interim 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 interim 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.

OPERA

The national research programme on geological disposal OPERA (OnderzoeksProgramma Eindberging Radioactief Afval, English translation: research programme disposal radioactive waste, 2011-2017) ended in December 2017. 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.

In OPERA, an initial Safety Case for the geological disposal of radioactive waste and spent fuel in Boom Clay[101, 102] has been developed. The Safety Case indicates that a stable and robust disposal at 500 meters depth in Boom Clay is possible, although several uncertainties are still to be further investigated. The Safety Case also contains a road map for future research. Based on this road map, COVRA is planning to start a continuous research programme on geological disposal in 2020.

A separate, complementary report[103] of the OPERA Advisory Group deals with the societal issues of geological disposal, including stakeholder engagement and conditions for the long-term decision-making process on disposal.

OPERA has focussed upon the Boom Clay: salt formations and other clay formations are also viable options for geological disposal. Salt as host formation has been explored in the past in the Netherlands and a limited update study has been carried out in OPERA. Much of the information and many of the approaches developed in OPERA are directly transferrable to evaluation of these other formations (e.g., work on waste types, inventories, packaging, overlying geological formations, safety assessment modelling).

[101] Summary of OPERA initial Safety Case: https://zoek.officielebekendmakingen.nl/blg-830955.
[102] OPERA initial Safety Case: https://zoek.officielebekendmakingen.nl/blg-830956.
[103] Report of OPERA Advisory Group: https://zoek.officielebekendmakingen.nl/blg-830958.

Annex 5. IRRS-mission and follow-up mission

IRRS 2014 mission

An international team of 20 nuclear safety and radiation protection experts and 5 IAEA staff members met with representatives of the former Ministry of Economic Affairs, the Ministry of Health, Welfare and Sport and the Ministry of Infrastructure and Water Management of the Netherlands from 3 to 13 November 2014.

Special attention was given to regulatory implications in the national framework for safety of the TEPCO-Fukushima Daiichi accident. The IRRS mission covered all nuclear and radiological facilities and activities regulated by the Netherlands. IRRS team members observed inspections at various facilities, among which the Borssele NPP. The IRRS team did not find an significant issue related to implications of the TEPCO Fukushima Daiichi accident. The IRRS team observed that all Dutch counterparts were committed to provide as good as possible regulatory functions covering a small but complex and diverse nuclear programme and a diverse range of activities with radioactive sources in the country. The IRRS team found that the main challenge was a consolidation of the administrative structure.

The good practices identified by the IRRS team are the Dutch system for recovery of orphan sources of ionizing radiation in scrap metal and the regulatory body's initiative to create an international forum of nuclear regulators of countries operating nuclear power plants of German origin.

The IRRS team identified certain issues needing attention or in need of improvement and believes that consideration of these would enhance the overall performance of the regulatory system. Most important are:

- National policies on nuclear and radiation safety, radioactive waste management and associated financial provisions for decommissioning and disposal should be consolidated with a special emphasis on assuring sustainability of human resources in the future.
- The new regulatory body should ensure that its structure and organization promote a common safety culture which will enable regulatory functions to be discharged in an integrated and coordinated manner.
- The regulatory body should be assured independence from undue political influence. The communication and cooperation between different parts of the regulatory body should be enhanced. Sufficient resources should be made available.
- The integrated management system of the regulatory body should be finalized and should include descriptions of all relevant processes, systematic training and qualification of regulatory staff, consolidation of the various safety-related records systems and document management systems.
- The regulatory body should further develop and periodically review regulations and guides to improve consistency, clarity and transparency in the licensing processes of the different facilities and activities and to strengthen the regulatory framework in the area of emergency preparedness and response as well as patient and public protection.
- Inspections should be systematically planned and prioritized. Inspection findings should be effectively tracked and the effectiveness of enforcement should be periodically reviewed.

The IRRS team noted that the Dutch Council of Ministers decided on 24 January 2014 that the expertise in the area of nuclear safety and most of the expertise on radiation protection will be brought together in a single new administratively independent authority. In fact from January 1st, 2015 the new organization started as the Authority for Nuclear Safety and Radiation Protection (ANVS). The IRRS report can be found at the ANVS website[104].

Follow-up mission November 2018

In November 2018 a follow-up mission took place. The follow-up mission (4 years after the original) visited the Dutch regulatory body in a completely new situation, since the ANVS had been established in 2015. There was also a new management, and none of the present management team members had experienced the 2014 mission. On the other hand, after the structuring of the organization in 2016, the management team has strongly lead the organization to complete the implementation of the recommendations and suggestions of the first IRRS mission. As a result, out of

[104] http://www.autoriteitnvs.nl/documenten/publicatie/2015/5/1/irrs_to_the_netherlands.

45 recommendations and suggestions, finally 26 were fully closed, and 18 were closed by the IRRS review team with confidence that they will be implemented within a reasonable time and only one recommendation was kept open. The latter deals with the set up and implementation of clearance levels of a greenfield after dismantling of an installation or termination of an activity. The Netherlands strives to complete this issue in 2020/2021.

The mission reports have been published and sent to the European Commission and Member States.

The Government has requested the next IRRS mission to the Netherlands during the first half of 2023.

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