Ministry of Infrastructure and Water Management

Kingdom of the Netherlands

Report to the 10th Review Meeting of the Convention on Nuclear Safety

August 2025

Foreword

On 20 September 1994, the Kingdom of the Netherlands signed the Convention on Nuclear Safety. It was subsequently formally ratified on 15 October 1996 and entered into force on 13 January 1997. The Convention obliges each Contracting Party to apply widely recognised principles and tools in order to maintain a high level of safety at its nuclear power plants. It also requires each Contracting Party to report on the national implementation of these principles to meetings of the parties to the Convention.

The present report has been prepared by the Kingdom of the Netherlands for the 10th Review Meeting of the Contracting Parties to the Convention on Nuclear Safety. It shows how it meets the obligations of each of the articles of the Convention.

Regular Review Meetings of Contracting Parties offer an important opportunity to share information related to implementation of the Convention, and as such the Kingdom of the Netherlands will continue to actively participate. The Kingdom of the Netherlands attaches great importance to the Convention, as well as to the Vienna Declaration on Nuclear Safety that was unanimously adopted by Contracting Parties in 2015, as essential to international efforts to strengthen nuclear safety. As this report demonstrates, the Kingdom of the Netherlands has developed, and continues to improve a robust domestic framework for nuclear safety in line with its international obligations.

Next to this, this report pays specific attention to the identified challenges for the Kingdom of the Netherlands, as well as the major common issues identified. Furthermore, the report also describes the most important new and future developments.

The information provided by the present report applies to the situation in the European part of the Kingdom of the Netherlands as of June 1st 2025, and does not apply to the Caribbean parts of the Kingdom, as per the Convention. Updates to the information presented in this report may be provided at the Convention on Nuclear Safety peer review meeting in April 2026.

This report has been prepared by the Authority for Nuclear Safety and Radiation Protection, the ANVS.

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Acronyms, Abbreviations, and Definitions

Abbreviation	Full term	Translation or explanation (in brackets)
ACD	Algemeen Coördinerend Deskundige	General Coordinating Expert
AIM	ANVS Integrated Management System	
ALARA	As Low As Reasonably Achievable	
AM	Ageing Management	
AMAT	Ageing Management Assessment Team	
ANS	American Nuclear Society	
ANR	Advanced Nuclear Reactor	
ANSI	American National Standards Institute	
ANVS	Autoriteit Nucleaire Veiligheid en Stralingsbescherming	Authority for Nuclear Safety and Radiation Protection
AOT	Allowed Outage Time	
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency	
ASME	American Society of Mechanical Engineers	
ASNR	Autorité de Sûreté Nucléaire et de Radioprotection	French Authority for Nuclear Safety and Radiation Protection
AWB	Algemene Wet Bestuursrecht	General Administrative Act
Bbs	Besluit basisveiligheidsnormen stralingsbescherming	Decree on Basic Safety Standards for Radiation Protection
Bkse	Besluit kerninstallaties, splijtstoffen en ertsen	Nuclear Installations, Fissionable Materials and Ores Decree
Bvser	Besluit vervoer splijtstoffen, ertsen en radioactieve stoffen	Fissionable Materials, Ores and Radioactive Materials Transport Decree
CENELEC	Comité Européen de Normalisation Electrotechnique	European Committee for Electrotechnical Standardization
CETsn	Crisis Expert Team straling en nucleair	Crisis Expert Team radiation and nuclear
Cmer	Commissie voor milieueffectrapportage	Committee for environmental impact assessment
CNRA	Committee on Nuclear Regulatory Activities	
CODAP	Component Operational Experience, Degradation and Ageing Programme	
ConvEx	Convention Exercise	
COVRA	Centrale Organisatie voor Radioactief Afval	Central Organisation For Radioactive Waste

CSA	Complementary Safety Margin Assessment	
CSNI	Committee on the Safety of Nuclear Installations	
CSO	Continued Safe Operation	
DiD	Defence in Depth	
DSR	Dutch Safety Requirements	
ECR	Emergency Control Room	
ECUREX	ECURIE Exercise	
EIA	Environmental Impact Assessment	
ENSREG	European Nuclear Safety Regulators Group	
EOP	Emergency Operating Procedure	
EP&R	Emergency Preparedness & Response	
EPD	Electronic Personal Dosimeter	
EPREV	Emergency Preparedness Review	
EPRSC	Engineering and Physical Sciences Research Council	
EPZ	NV Elektriciteits-Productiemaatschappij Zuid-Nederland	Operator of Borssele NPP
ERBVC	Externe Reactor Bedrijfs Veiligheids Commissie	External Reactor Safe Operation Committee
ERO	Emergency Response Organisation	
ERSC	External Reactor Safety Committee	
ESFAS	Engineered Safety Features Actuation System	
ET-NL	Enrichment Technology Nederland	Subsidiary of ETC Ltd
ETSON	European Technical Support Organisation Network	
FANC	Federaal Agentschap voor Nucleaire Controle	Federal Agency for Nuclear Control (Belgium)
FRP	Function Recovery Procedure	
FINAS	Fuel Incident Notification and Analysis System	
FSG	Flex Support Guidelines	
HEAF	High Energy Arcing Fault	
HERCA	Heads of the European Radiological Protection Competent Authorities	
HEU	High Enriched Uranium	
HFE	Human Factors Engineering	
HFR	Hogefluxreactor	High Flux Reactor
HOR	Hoger Onderwijs Reactor	

HPES	Human Performance Enhancement System	
I&W	Ministerie van Infrastructuur en Waterstaat	Ministry of Infrastructure and Water Management
ICDE	International Common-cause Failure Data Exchange	
IEC	International Electro-Technical Committee	
IEEE	Institute of Electrical and Electronics Engineers	
IGALL	International Generic Ageing Lessons Learned	
ILT	Inspectie Leefomgeving en Transport	Human Environment and Transport Inspectorate
IMG	Inspectie Militaire Gezondheidszorg	Military Healthcare Inspectorate
IMS	Integrated Safety Management System	
INES	International Nuclear Event Scale	
INSAG	International Nuclear Safety Group	
INSARR	Integrated Safety Assessment of Research Reactors	
IPSART	International PSA Review Team	
IRS	Incident Reporting System	
IRSC	Internal Reactor Safety Committee	
IRSRR	Incident Reporting System for Research Reactors	
ISI	In Service Inspection	
ISLOCA	Inter-System Loss of Coolant Accident	
IVR	In-vessel Retention	
JRC	Joint Research Centre	
Kew	Kernenergiewet	Nuclear Energy Act
KGG	Ministerie van Klimaat en Groene Groei	Ministry of Climate and Green Growth
KNMI	Koninklijk Nederlands Meteorologisch Instituut	Royal Netherlands Meteorological Institute
KTA	Kerntechnischer Ausschuss	Nuclear Safety Standards Committee
KWUREG	KWU Regulators	
LCP-S	Landelijk Crisisplan Straling	National Emergency Radiation Plan
LEU	Low Enriched Uranium	
LFR	Low Flux Reactor	
LH	Licence Holder	
LOCA	Loss of Coolant Accident	
LPSA	Living Periodic Safety Assessment	
LTO	Long-term Operation	

mSv	Millisievert	
µSv	Microsievert	
MWe	Megawatt electrical	
MWth	Megawatt thermal	
MAAP4	Modular Accident Analysis Programme	
MCR	Main Control Room	
MELODI	Multidisciplinary European Low Dose Initiative	
MR NV	Ministeriële Regeling Nucleaire Veiligheid Kerninstallaties	Ministerial Nuclear Safety Regulation for Nuclear Installations
MSLB	Main Steam-Line Break	
NAcP	National Action Plan	
NAR	National Assessment Report	
NCC	Nationaal Crisiscentrum	National Crisis Centre
NDRIS	National Dose Registration and Information System	
NEA	Nederlandse Emissie Autoriteit	Dutch Emissions Authority
NIN	Nieuwe Initiatieven Nucleair	New Initiatives Nuclear
NNR	National Nuclear Regulator	
NPP	Nuclear Power Plant	
NR	National Report	
NRC	Nuclear Regulatory Commission	
NRG	Nuclear Research and Consultancy Group	Nuclear consultancy company, TSO and operator of the HFR
NSD	Nuclear Safety Directive	
NSSC	Nuclear Safety and Security Commission	
NV&KZ	Nucleaire Veiligheid en Kwaliteitszorg	Nuclear Safety and Quality Assurance Department
NVD	Nucleaire Veiligheidsdienst	Nuclear Safety Officer
NVR	Nucleaire Veiligheidsregels	Nuclear Safety Rules
NVWA	Nederlandse Voedsel en Waren Autoriteit	Netherlands Food and Consumer Product Safety Authority
OECD	Organisation for Economic Co-operation and Development	
ONR	Office for Nuclear Regulation (UK)	
OSART	Operational Safety Review Team	
PAA	Państwowa Agencja Atomistyki	National Atomic Energy Agency (Poland)
PAM	Post-Accident Management	
PIE	Postulated Initiating Event	
PORV	Pilot Operated Relief Valve	
PSA	Periodic Safety Assessment	

PSR	Periodic Safety Review	
PUC	Platform Implementation Content	
PWR	Pressurised Water Reactor	
PWROG	Pressurised Water Reactor Owners Group	
QMS	Quality Management System	
RASSC	Radiation Safety Standards Committee	
RB	Regulatory Body	
REMM	Radiological Expert Team Measurements & Modelling	
RGEN	Radiologisch en Gezondheidskundig Expertise Netwerk	Radiological and Health Expertise Network
RID	Reactor Instituut Delft	Reactor Institute Delft
RIVM	Rijksinstituut voor Volksgezondheid en Milieu	National Institute for Public Health and the Environment
RM	Review Meeting	
ROK	Republic Of Korea	
RPS	Reactor Protection System	
RR	Research Reactor	
RSK	Reaktor Sicherheitskommission	Reactor Safety Committee
RTD	Röntgen Technische Dienst	Röntgen Technical Service
RWS	Rijkswaterstaat	Department of Waterways and Public Works
SALTO	Safety Aspects of Long Term Operation	
SAMG	Severe Accident Management Guidelines	
SAR	Safety Analysis Report	
SBO	Station Black Out	
SCC	Safety Health and the Environment Checklist Contractors	
SGTR	Steam Generator Tube Rupture	
SMART	Specific Measurable Acceptable Realistic Time-bound	
SMR	Small Modular Reactor	
SODM	Staatstoezicht op de Mijnen	Dutch State Supervision of Mines
SR	Safety Report	
SZW	Sociale Zaken en Werkgelegenheid	Ministry of Social Affairs and Employment
TIP	Technical Information Package	
TLD	Thermoluminescent Dosimeter	
TPR	Topical Peer Review	
TRANSSC	Transportation Safety Standards Committee	
TS	Technical Specifications	

TSO	Technical Service Organisation	
URENCO	URanium ENrichment COmpany	
VCA	Veiligheid, Gezondheid en Mileau	Safety, Health and Environment
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik	Association for Electrical, Electronic & Information Technologies
VDNS	Vienna Declaration of Nuclear Safety	
VOBK	Veilig Ontwerp en het Veilig Bedrijven van Kernreactoren	Safe Design and Safe Operation of Nuclear Power Plants
VWS	Ministerie van Volksgezondheid, Welzijn en Sport	Ministry of Health, Welfare, and Sport
WABO	Wet Algemene Bepalingen Omgevingsrecht	Environmental Permitting Act
WAKO	Wet Aansprakelijkheid Kernongevallen	Act on the Liability for Nuclear Accidents
WANO	World Association of Nuclear Operators	
WASSC	Waste Safety Standards Committee	
WENRA	Western European Nuclear Regulators Association	
WFSR	Wageningen Food Safety Research	
WRZO	Wet Rampen en Zware Ongevallen	Major Accidents Act
WVR	Wet Veiligheidsregio's	Safety Region Act
ZBO	Zelfstandig Bestuursorgaan	Independent Administrative Authority

Introduction

About this report

This National Report (NR) fulfills the Netherlands' obligations under Article 5 of the Convention on Nuclear Safety (CNS). It was prepared by the Dutch Authority for Nuclear Safety and Radiation Protection (ANVS). The Netherlands is a Category 2 (Small Programme) Contracting Party to the CNS. As such, it has reported under Articles 6 to 19.

This introduction presents a short overview of the ANVS, the Dutch civil nuclear programme, and its history. This is followed by a description of the national policy towards nuclear activities in the Netherlands and the main safety issues of the reporting period. The introduction finishes with a description of the structure of the report.

Regulatory Body

In the present report, the competent regulatory authority or 'Regulatory Body' (RB) is the entity designated by the government as having legal authority for conducting the regulatory processes, including issuing authorisations, supervision and enforcement, and thereby regulating nuclear safety, security and safeguards, radiation protection, radioactive waste management and transport safety. The ANVS is legally independent in its regulatory decision making on radiation protection, nuclear safety and security in the Netherlands.

The legal status of the ANVS came into force on August 1st 2017.

The tasks related to nuclear safety as described under Article 8 of the Convention, are within the scope of the ANVS only. Therefore this report refers to the ANVS as the RB.

Recent developments are described in the Summary and in the text on Article 7, as far as it concerns developments in associated enabling regulation, and in the text on Article 8 where it concerns the ANVS and its tasks.

The Ministry of Infrastructure and Water Management (I&W) is politically responsible for the functioning of the ANVS and has final responsibility for the effective operation of the ANVS. The Ministry is led by a Minister and State Secretary, the latter of whom has ANVS in their portfolio.

The Ministry of I&W allocates sufficient financial resources for the ANVS to carry out its duties.

Nuclear programme

The Netherlands has one operating nuclear installation and one in permanent shut down, as defined by the CNS:

Table 1 Relevant nuclear installations

Location	Licence Holder	Unit	Type	First Criticality	Capacity (Mwe)	Status
Borssele	EPZ	NPP Borssele	PWR	1973	485 MWe	Operating
Dodewaard	GKN	NPP Dodewaard	BWR	1968	60 MWe	Shut down

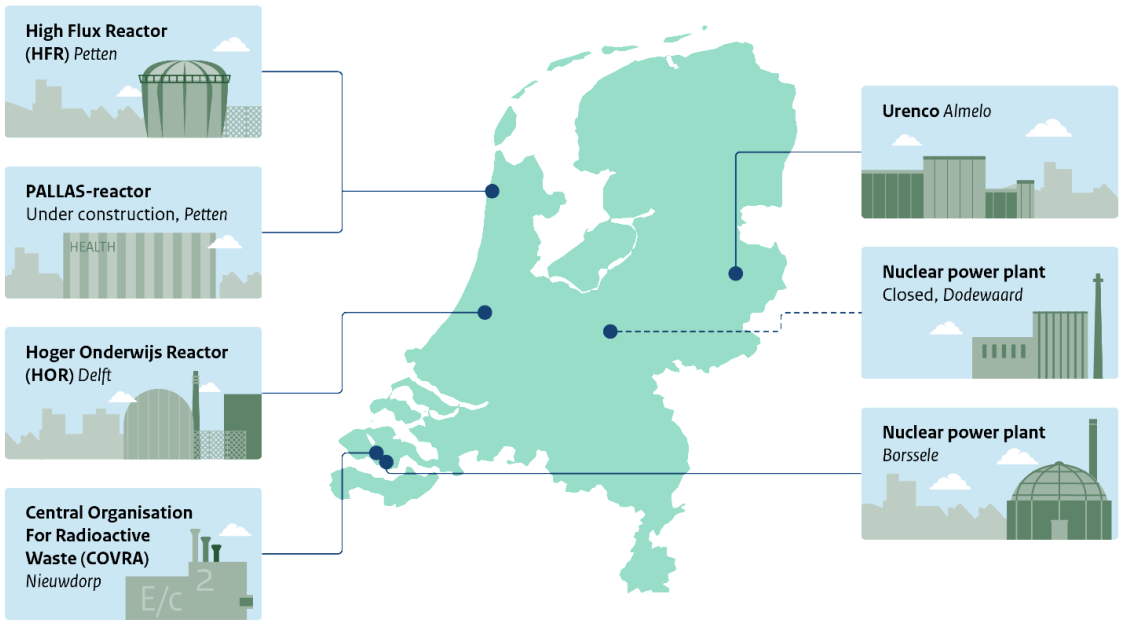
According to Article 3 of the Convention, the Convention shall apply to the safety of 'nuclear installations'. Article 2 of the Convention defines 'nuclear installations' as civil land-based nuclear power plants and facilities located on the same site as the NPP and related to its operation. Installations therefore not subject to the Convention are:

- Two research reactors in operation. One is located on the premises of the Delft University of Technology ('Hoger Onderwijs Reactor', HOR, 2,3 MWth) and one located on the Research Location Petten (High Flux Reactor, HFR, 45 MWth).
- Additional nuclear research facilities and laboratories can be found at the Delft University of Technology and in Petten (Nuclear Research & Consultancy Group, NRG and the EU Joint Research Centre, the JRC).
- In the eastern part of the country, in Almelo, the uranium enrichment facilities of Urenco Netherlands (uranium enrichment) and Enrichment Technology Netherlands (ET-NL, development and production of centrifuge technology) are located. The licenced capacity currently is 6200 tSW/a.

- In the south-west of the country, in the municipality of Nieuwdorp, the COVRA interim radioactive waste storage facility is located. COVRA has facilities for the storage of conditioned low, intermediate and high level waste. The latter category includes spent fuel of research reactors and waste from reprocessing of spent fuel of NPPs. More information on COVRA can be found in the Netherlands' various editions of the national report for the Joint Convention on the Safe Management of Radioactive Waste and the Safe Management of Spent Fuel.

The nuclear programme in the Netherlands features a number of steps of the nuclear fuel cycle. Some of the Dutch nuclear businesses have a global impact. Urenco supplies a major part of the world-demand for low-enriched uranium. Its plant in Almelo represents more than a quarter of the total production capacity. The company ET-NL in Almelo supplies all centrifuges for the enrichment plants of Urenco and Orano – world-wide. The HFR in Petten, on average supplies 70% of the European demand for radio-isotopes – and 30% of the global demand. The PALLAS reactor is currently under construction to replace the HFR. NRG, the HFR and several nuclear research facilities in addition provide consultancy services to clients on several continents. Furthermore, scientists of the Dutch universities and NRG participate in many national and international nuclear research programmes.

Figure 1 Locations of nuclear power plants, research reactors and other facilities of the nuclear programme



Short history of the nuclear programme

The nuclear programme started with the construction of a research reactor in 1955, the HFR in Petten, which achieved first criticality in 1961. It was originally thought that nuclear power would play an important role in the country's electricity generation programme. A small prototype reactor (Dodewaard NPP, 60 MWe) was put into operation in 1968, and in 1973 this was followed by the first commercial reactor (Borssele NPP, 485 MWe).

Although plans were made to expand nuclear power by 3000 MWe, these were shelved following the accident at Chernobyl in 1986. Instead, the government ordered a thorough screening of the safety of both plants. This led to major backfitting projects at both of them to improve nuclear safety. The backfitting project at Borssele was successfully completed in 1997. Meanwhile, mainly because of the negative expectations for the future of nuclear energy in the Netherlands, the small Dodewaard NPP was permanently shut down in 1997. In 2005 the owner of this NPP was granted a licence for a safe enclosure state for a period of 40 years, after which final dismantling shall commence.

In 2006,the Dutch government signed an agreement with the owners of the Borssele NPP, which allows for operation until the end of 2033, at the latest. In the meantime, the conditions of the agreement should be met, next to the requirements of the Kernenergiewet (Nuclear Energy Act) and the licence. The aforementioned end-date of operation is also a requirement in article 15a of the Nuclear Energy Act. For an update on its status, refer to information in the text on Article 6 of the Convention.

In 2009, plans were revealed by the companies Delta N.V. and Essent/RWE for a new NPP at the site of the Borssele NPP. Early 2012 both plans were shelved, considering the economic environment and the uncertainties it introduced.

In 2017 Delta N.V., main owner of Borssele NPP, was split into three parts. This was required because of national legislation requiring unbundling of generation and network activities.

In 2021 the coalition agreement of the former government decided to pursue the construction of two new nuclear power plants and keep the Borssele NPP open as long as can be safely allowed.

A new research reactor (named PALLAS) is under construction in order to replace the HFR. In June 2022 the project applied for a licence, which was granted by the ANVS in March 2023. Construction of the pit and foundation started in May 2023, with the reactor expected to be completed by 2030.

The Delft University of Technology has conducted the project OYSTER to upgrade the research facilities in its research reactor. OYSTER was jointly financed by the university and the national government. The work was completed in late 2024.

Current national policy

Policy on new nuclear power

In September 2024, the new government coalition presented its plans for the coming years. It included the pursuit of a strong reduction in greenhouse gas emissions. As part of this, there are plans to take the necessary steps for the construction of up to four new nuclear power plants (an addition of two new nuclear power plants compared to the coalition agreement of 2021). The plan to extend the operating life of the Borssele nuclear power plant of the former coalition was also reconfirmed. The government furthermore decided to explore the possibilities of small modular reactors.

According to the coalition agreement, nuclear energy can complement sun, wind and geothermal energy in the energy mix and can be used to produce hydrogen. It would also make the Netherlands less dependent on gas imports. This coalition will, among other things, facilitate market parties in their explorations, support innovations, invite tenders, review the (financial) contribution of the government, and prepare legislation and regulations where necessary. The agreement also states that safe, permanent storage of nuclear waste will be ensured.

Policy on the safe management of spent fuel and nuclear waste

Spent fuel management and waste management are not the subject of the Convention on Nuclear Safety, therefore this topic is not addressed in the present report. For more details, refer to the most recent editions of the National Report for the 'Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management', the National Report for the Council Directive 2011/70/EURATOM and the National Programme for the management of spent fuel and radioactive waste.

Main safety issues: Post-Fukushima Daiichi developments

Following the events at the Fukushima Daiichi nuclear power plant in March 2011, the international community launched several interrelated initiatives to learn from these events and to initiate dedicated programmes to further enhance nuclear safety. For the Netherlands, the most important ones are 1) the 'stress test' led by the European Nuclear Safety Regulatory Group, ENSREG[1], 2) actions undertaken by the IAEA under the umbrella of the Convention on Nuclear Safety (CNS), and 3) actions associated with the Vienna Declaration on Nuclear Safety (VDNS[2]).

All post-Fukushima Daiichi measures identified in the Netherlands have been recorded in the Dutch National Action Plan (NAcP[3]) which was subject to European peer review in 2013 and in 2015. The NAcP incorporates findings from the national assessment, the review under the umbrella of ENSREG and the review under the umbrella of the CNS[4].

The measures require actions at the Licence Holder (LH), but also some at the ANVS. However, various measures listed in the NAcP originate from the previously conducted regular Periodic Safety Reviews (PSRs) of the LH and not from the

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[1] Stress test, more precisely formulated as 'Complementary Safety margin Assessment' (CSA)

[2] Vienna Declaration on Nuclear Safety - On principles for the implementation of the objective of the Convention on Nuclear Safety to prevent accidents and mitigate radiological consequences,
CNS/DC/2015/2/Rev.1, published February 9, 2015

[3] Netherlands' National Action Plan (NAcP) for the follow-up of post-Fukushima Daiichi related activities, Report December 2012 for the ENSREG-led NAcP Peer Review Workshop to be held in April 2013. It was updated in 2014, 2017 and 2020

[4] Findings from the 2nd Convention on Nuclear Safety (CNS) Extraordinary Meeting in August 2012 and CNS-6. Also refer to 'The Netherlands' National Report For the 2nd Convention on Nuclear Safety Extraordinary Meeting to be held in August 2012', published in May 2012

so-called ‘stress test’. All actions at the NPP and the RB have been completed. Refer to the Summary section, of which Part II provides more information on the measures to be implemented.

It should be noted that the safety of all nuclear facilities in the Netherlands (and not only the Borssele NPP) has been evaluated in ‘stress tests’.

Structure of the report

This updated report follows the format of the previous national report for the Convention on Nuclear Safety, submitted in 2022. The present report complies with the guidelines presented in the latest update of INFCIRC/572. In drafting the report, notice is also taken of the Vienna Declaration on Nuclear Safety (VDNS), letters of the president of the 10th Review Meeting, notes of the Informal Meeting of Nuclear Regulators on following up the VDNS16 (for VDNS see Summary Part III) and the template provided by the group of experts to support reporting on Article 17 and Article 18 of the CNS. Furthermore, note has also been taken of the newly released Template for National Reports, as released in early 2025.

The present report is designed to be a ‘stand-alone’ document to facilitate peer review. However some information contained in the CNS National Report for the combined 8th and 9th CNS Review Meeting was not repeated, and readers are referred to that report for such information.

The present report offers an article-by-article review of the situation in the Netherlands with regard to the obligations imposed by the Convention. The numbering of its chapters and sections corresponds to that of the articles in the Convention. Several appendices provide further details of the regulations and their applications, and factual data, and references to other relevant material. A summary of the answers to the identified challenges for the Netherlands are mentioned in the corresponding Articles, and summarised on the following page.

Summary

The Netherlands is a Category 2 Contracting Party. As such, it has reported on all Articles of the CNS. There is a special Part II in this Summary, dedicated to post-Fukushima Daiichi measures. Part III of the Summary contains a description of how the Vienna Declaration on Nuclear Safety has been implemented in the Netherlands and in what way the Regulatory Body contributes to its worldwide implementation.

PART I, REGULAR CNS TOPICS

Summary of Responses to Applicable Challenges and Suggestions and Areas of Good Performance

The Netherlands has addressed the Challenges and Suggestions that remained open from previous RMs as follows:

Challenge 2023-01: "ANVS managing the (need for) fast growing human resources (Article 8):

- Recruitment efforts in a tense labour market in competition with industry
- Dealing with the fast growing number of new workers (training/tutoring)
- Prevention of existing and new workers leaving (worker satisfaction)"

The ANVS is able to manage the workload and attract a significant number of new employees. The ANVS has a multi-year capacity building plan – broken down into function groups – to facilitate this growth. A new traineeship programme is also starting in September 2025. The ANVS Academy meanwhile offers training and tutoring opportunities for new workers and personal development options for existing workers. For more information we refer to the text in Article 8.

Challenge 2023-02: "Readiness for the developments from the Government plan on nuclear energy and SMRs (Article 6)

- Evaluation of nuclear framework (Ministry I&W)
- Preparing for (pre-licensing of new NPPs, 2nd LTO, SMRs, ANR (ANVS)"

The Nuclear Framework has been evaluated by the Ministry of I&W. Meanwhile, internally at the ANVS the New Initiatives Nuclear Programme (NIN) has been launched. The ANVS also takes part in the SMR programme, initiated by the Ministry of Climate and Green Growth. For more information we refer to the text in Article 6.

Challenge 2023-03: "Attacks on automation systems: The threat of (digital) attacks on automation systems is growing rapidly, both nationally and internationally. The associated risks may increase as more operational technology systems are digitally and remotely controlled. In the nuclear domain, both criminal and state actors are considered as a threat. It is important to be remain alert in order to minimise such risks in the nuclear sectors. The ANVS cooperates with LHs and various national security services in this field." (Article 8)

In 2023 the state issued an updated 'Design Basis Threat' (DBT) document in which more attention is paid to digital threats to the LHs. For more information we refer to the text in Article 8.

The following 'Areas of Good Performance' were noted in the CRR:

Area of Good Performance 2023-01: In 2019-2021, the High Flux Reactor (HFR) research reactor underwent a full scope PSA. This is the first research reactor in the world to have undergone a full scope probabilistic safety assessment.

Area of Good Performance 2023-02: updating of regulations and the nuclear energy act to create an independent ANVS.

Area of Good Performance 2023-03: The ANVS provides specialised training for its staff and has a dedicated education plan for each function group. Currently, efforts are made to integrate the education plans and the relevant trainings into a single platform: the ANVS Academy. This learning & development platform offers training in technical aspects as well as personal development. This platform was launched in June 2022 and will continue to grow.

Area of Good Performance 2023-04: After 50 years the granting of a construction licence for a reactor (PALLAS):

- First complete reactor reviewed against the state-of-the-art technical guidelines (VOBK).
- Experiences with this trajectory are used in the preparation and/or (pre-licensing for new projects (NPP/Shine) and in the ANVS processes.

Area of Good Performance 2023-05: Early anticipation on the new developments:

- Taking a proactive approach in anticipation of nuclear development programme from the lessons learned from licensing of the PALLAS reactor and planning for different growth scenarios for nuclear expansion.
- This included over a 2 years' time frame, early preparations for 2nd LTO, (a.o. recap 1st LTO and enter IGALL).
- Reinforcements of human resources planning and recruitment, training and qualification, documentation management, etc.
- Updating of the Strategic Course Document.
- Evaluation and decision to adjust the organisation by February 2023 Amongst others: more flexibility to developments.
- Large campaign to recruit new staff (30% growth to 150+ in 2022).
- Long term contract new TSO.

Area of Good Performance 2023-06: Creation, in recent years, of extensive information for licencees on ANVS' policy on licensing, inspection and enforcement and more:

- Already being updated based on experience with the implementation.
- Explanation in detail of the application of the 'intervention matrix' for proportionate enforcement.

Summary of Other Significant Changes Since Previous Report

Article 6

- Lifetime extension for Borssele NPP is currently being investigated.
- Licensing of PALLAS RR in 2023 and start of construction of pit and foundation.
- Completion of OYSTER project at HOR RR in 2024.
- Since 2024 COVRA holds the shares for the NPP Dodewaard.
- Preparations by the ANVS for new initiatives:
    - ANVS and Ministry of I&W participation in SMR programme, initiated by Ministry of Climate and Green Growth;
    - Further investigation of the ANVS into maritime nuclear applications;
    - In 2024 the ANVS and the French regulator started a collaboration for a preparatory review of the Thorizon design (molten salt thorium reactor);
    - Review of self-evaluation by three vendors of large power reactors against Dutch regulations and guides by the ANVS in early 2025;
    - Start of NIN programme within the ANVS in 2024 to address these new developments.
- Various (follow-up) missions carried out at nuclear installations in the Netherlands:
    - INSARR mission at HOR in 2021, with a follow-up in 2024;
    - PSR mission at HFR in 2022;
    - CSO mission carried out at HFR in 2022, with a follow-up in 2024;
    - The final National Action Plan (NAcP) of the TPR Ageing Management was sent to ENSREG in late 2023;
    - PSR mission at NPP Borssele in 2023;
    - OSART mission carried out at NPP Borssele in 2023, with a follow-up in 2025;
    - Pre-SALTO mission at NPP Borssele in 2024;
    - TPR Fire Protection was carried out in 2024;
    - WANO peer review carried out at NPP Borssele in 2025.

Article 7

- On the 1st of January 2023, a new assessment framework for acceptance of alternative packages of reprocessed fuel came into force.
- The ANVS-Regulation on Basic Safety Standards for Radiation Protection was amended on July 1 2023 in connection with the determination of the maximum period within which radioactive waste and fissile materials or ores containing waste must be removed.
- On the 1st January 2024, the new Environment and Planning Act came into force.
- As of January 1st 2025 the Nuclear Facilities, Fissionable Materials and Ores Decree also regulates the main security principles for nuclear installations and fissile materials.

- This Ministerial Decree with regard to Nuclear Pressure Equipment Regulation, Security and Decommissioning, as amended on January 1 2025, now includes provisions for other pressure equipment.
- The ANVS Regulation regarding the Ministerial Decree mentioned above entered into force on January 1 2025.
- Update of the Supervision and Enforcement Strategy in 2023, including a redesign of the intervention matrix.

Article 8

- Further expansion of communications activities by the ANVS.
- Participation of ANVS employees in various IAEA missions.
- Further growth of the ANVS in employee numbers from 121 FTE in 2021 to 176.8 FTE in 2024.
- In 2021 a contract was signed by the ANVS with a consortium of Bel V, ASNR and Bureau Veritas from Belgium and France, for a minimum of ten years.
- Launch of the ANVS Academy in 2022.
- Publishing of State of Nuclear Safety Document by the ANVS in 2022.
- Change of internal ANVS structure in 2023.
- Release of Design Basis Threat Document by the state in 2023.
- New cooperation agreements signed with Regulatory Bodies of South Africa (2023), France (2023), UK (2024), South Korea (2024) and Poland (2024) by the ANVS.
- The Netherlands received IRRS, ARTEMIS and IPPAS missions in 2023.
- Start of ANVS Integrated Management (AIM) Programme in 2023.
- Start of Nuclear Academy in 2023 by NRG and Delft University of Technology.
- Launch of a new programme to develop a new case management system of the ANVS as well as to improve information-based work by the ANVS (programme BOSON) in 2024.
- Hosting of annual KWUREG meeting in 2024 by the ANVS.
- Start of use of Publication Platform Implementation Content (PUC) by the ANVS in 2024.
- Formalisation of transfer of responsibility for task ‘Evaluating and preparing policies, acts and regulations’ to the Ministry of I&W by change in Nuclear Energy Act in 2024.
- Launch of the ANVS traineeship in 2025.

Article 11

- The simulator of the NPP Borssele moved from Essen (Germany) to Borssele in 2024.
- In addition to the full-scope control room simulator the LH now also has updated dedicated rooms for practical training.
- Launch in 2024 of a dedicated programme by the national government on nuclear knowledge infrastructure.

Article 16

- The structure of the Crisis Expert Team has been improved.
- In October 2024 the National Nuclear Crisis exercise Autumn Glow took place.

Notable achievements

- Update of the Supervision and Enforcement Strategy in 2023, including a redesign of the intervention matrix.
- Launch of the ANVS internal programme NIN (New Initiatives Nuclear) in 2024 to facilitate new initiatives as well as the LTO of NPP Borssele, while maintaining a healthy balance with current tasks and responsibilities.
- Facilitation of growth in coming years at the ANVS facilitated through multi-year capacity building plan.
- Launch of ANVS traineeship in 2025.
- New cooperation agreements signed with Regulatory Bodies of South Africa (2023), France (2023), UK (2024), South Korea (2024) and Poland (2024) by the ANVS.

Future Focus

- Continuing preparations by the ANVS for new initiatives concerning conventional NPPs, SMRs and other new technologies such as molten-salt reactor (project Thorizon) and maritime nuclear applications, as well as preparations for the LTO of NPP Borssele..
- Keeping the national regulatory framework up to date for new and future developments.
- Attract and train additional new employees at the ANVS to realise the growth ambitions, whilst simultaneously taking care of the absorptive capacity of the organisation and retention of current employees.

Planned improvements

Summary for NPP Borssele

- Improved prevention of station blackout situations;
- Improvements in electrical configurations and emergency power;
- Preventing deviations to the redundancy concept;
- Improved fire protection;
- Improvements in configuration management;
- Changes to emergency procedures;
- Simplification of commissioning and decommissioning procedures;
- Updating the probabilistic safety assessment;
- Implementation of a radioactive waste reduction programme;
- Improvements to the emergency response organisation;
- Improvement of the maintenance programme;
- Development of a technical obsolescence programme;
- Improvement of the personnel management process;
- Improvements to the radiation protection programme and reduction of the radiation exposure of workers.

Major common issues

At the previous RM, several major common issues were identified. Table 2 indicates where they are addressed in this report.

Table 2 Reporting on major common issues

Major Common Issue	Article, page
Managing extraordinary circumstances impacting the safe operation of nuclear installations	Article 17.1 | p. 117
Strengthening national regulatory capabilities taking into account new and innovative Technologies	Article 6.1(f) | p. 26 Article 8.1(h) | p. 62 Article 8.1(i) | p. 63
Fostering international collaboration	Article 6.1.f.3 | p. 27 Article 8.1 (g) | p. 60
Foster international peer review missions and timely addressing of findings	Article 6.2 (b, c, e) | p. 29 Appendix 6.3 | p. 174
Possible impact of global climate changes on the safe operation of nuclear installations	Article 17.1 | p. 117
Securing reliable supply chains	Article 19.5 | p. 135
Strategies for ageing management in support of the operation of nuclear installations	Article 6.2 | p. 28
Strengthening emergency preparedness and response arrangements and fostering cross border collaboration	Article 16.1.b.4 | p.111 Article 16.2 | p. 114

PART II POST-FUKUSHIMA DAIICHI MEASURES

Participation of the Netherlands in international self-assessment exercises

The Netherlands has participated fully in the post-Fukushima Daiichi activities led by ENSREG and by the IAEA (under the CNS umbrella). The LH (EPZ), operating the Borssele NPP, also participated in post-Fukushima WANO self-assessment exercises. The stress test benefited from these WANO self-assessments.

The final update of the NAcP (2019, published 2020) gives a summary of the national implementation of post-stress test actions. All NPP-related actions have been completed. In previous versions of the CNS National Report, the NAcP-tables with measures were reproduced and updated to reflect the situation at publication date. This CNS report provides the table with the remaining actions and the actual progress. All reports related to the stress test have been published and can be found on www.ensreg.eu or www.anvs.nl.

Table 3 Remaining post stress test measures

No Action	Topic	Action	Status
3.1, IAEA action plan	EPREV	Decision about EPREV mission	It was decided to apply for an EPREV mission. Mission is planned to take place in 2027.

On a voluntary basis, all other nuclear installations participated in the stress test. All resulting measures have been implemented.

PART III VIENNA DECLARATION

In this part of the Summary, the Netherlands reports about the implementation of the Vienna Declaration and the activities of the ANVS to promote worldwide implementation in cooperation with regulatory bodies of other countries.

1. *New nuclear power plants are to be designed, sited, and constructed, consistent with the objective of preventing accidents in the commissioning and operation and, should an accident occur, mitigating possible releases of radionuclides causing long-term off-site contamination and avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions;*

The 2009 EU Nuclear Safety Directive (NSD) of 2011 has been updated in 2014 and envelops the safety objectives of the Vienna Declaration. As required of EU Member States, transposition of the update into the Dutch regulatory framework was completed in August 2017.

2. *Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are to be implemented in a timely manner*;

This requirement has been implemented in a general way for all nuclear installations with the transposition of the abovementioned EU Directive (in 2011). Before that, licence conditions already required periodic safety reviews (every 10 years and every 2 years) at the Borssele NPP. One of the licence conditions also requires implementation of the identified safety improvements within five years after completion of the evaluation phase (unless this timeframe is not reasonable). This led to considerable improvements at the Borssele plant.

During 2017, 2018 and the first part of 2019, the ANVS participated in the IAEA activity to create a TECDOC that describes approaches how to deal with the safety improvement of existing NPPs.

In the framework of WENRA the ANVS is participating in a benchmark on the application and implementation of a series of Safety Reference Levels in the area of severe accidents (Issue F). The benchmark concerns measures that have been or will be implemented on the basis of safety assessments performed as part of assessments like a PSR or stress test.

The ANVS has also participated in an European Commission activity, carried out by ETSON, concerning practical implementation of articles of the Nuclear Safety Directive (2014), corresponding to the Vienna Declaration. It is about the approach to analyse, assess and implement safety improvements at existing NPPs.

Also refer to the text on Article 14 of the Convention in the present report for information on the instrument of PSRs. For more detailed information on these PSRs at the Borssele NPP and associated measures taken, refer to Appendix 4.

For the implementation of the requirements of the NSD (enveloping requirements of the VDNS) in the Dutch regulatory framework, refer to the text on Article 7 of the Convention in the present report.

3. *National requirements and regulations for addressing this objective throughout the lifetime of nuclear power plants are to take into account the relevant IAEA Safety Standards and, as appropriate, other good practices as identified inter alia in the Review Meetings of the CNS*.

Apart from the transposition of the NSD, already mentioned under points 1 and 2, the Dutch Safety Requirements (DSR) for new reactors are aiming at the same goal. The document containing the DSR is a guidance document. It has been created using IAEA standards and WENRA Objectives for new reactors. It will for instance be used as a reference for the next PSR at Borssele NPP (evaluation to be finished 2023) and as a guidance in the preparations for the PALLAS research reactor. For detailed information on the DSR, refer to Appendix 1.

The licence of the NPP Borssele contains a set of NVRs (Dutch acronym: 'Nucleaire Veiligheids Regels'), which are adapted IAEA requirements and guides. The set NVRs contains requirements and guides on Siting, Design, Operation, Management System, Safety Analyses and Emergency Preparedness and Response. The ANVS is working on a guidance document which aims to update this approach with direct reference to the up to date IAEA framework.

4. Measures that aim at fulfilling the objective for the existing reactor

In the chapters dealing with the Articles 14 and 18, and with all details in the Appendix 4, it is shown that through the subsequent PSRs a lot of backfitting measures have been and are being taken that reduce the core damage frequency to a level of modern reactors. The additional measures based on the stress test have increased robustness of the plant even further.

Article 6. Existing Nuclear Installations

6. Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

The Kingdom of the Netherlands fulfills the obligations of Article 6.

This chapter gives the information requested by Article 6 of the Convention. It contains:

- A list of existing and new installations.
- An overview of safety assessments which have been performed, and other evaluations.
- An overview of programmes and measures for upgrading the safety of nuclear installations, where necessary, and/or the timing of shut-downs.
- A description of the position of the Netherlands with respect to the further operation of the installations, based on a review of safety at the time when the Convention entered into force (i.e. 13 January 1997), plus details of the situation in the Netherlands regarding safety issues since the last review.

6.1 Existing and new installations

The Netherlands has one nuclear power plant in operation: the Borssele NPP (a PWR, Siemens/KWU design. 485 MWe). This is the only nuclear installation according to the definition in Article 2 of the Convention. We also report briefly on other installations in the Netherlands, as described below.

There also is one shut-down plant in ‘safe enclosure’: the Dodewaard NPP (a BWR, GE design, 60 MWe). In addition there are two research reactors in operation, the largest of which has a thermal power of 45 MW, the HFR in Petten. The second one is the HOR of the Technical University of Delft, which has a thermal power of 2,3 MW. A third research reactor, the Low Flux Reactor, LFR (30 kWth), was taken out of operation permanently in 2010 and its decommissioning was completed in 2018. Its decommissioning licence was revoked beginning 2019. The LFR is not further discussed in the present national report.

6.1(a) Nuclear Power Plant: Borssele NPP

The Borssele NPP is a two-loop Siemens PWR that has been in commercial operation since 1973. Its net electrical output is about 485 MWe. In 2006 a covenant was signed by the operator and owners of the plant and the government, stating that the plant shall cease operation no later than 31 December 2033. Notwithstanding this covenant, the requirements of the Nuclear Energy Act and the licence shall be complied with at all times. The final date of electricity production was also included in the Nuclear Energy Act.

In 2012 the Safety Report was updated and time-limited ageing analyses were performed to cover 60 years of operation (instead of the 40 years documented previously). The updated Safety Report showed that safe operation of the Borssele power plant is technically feasible until at least 2033. The licence

(which is not time-limited) was modified to include the new Safety Report. No modification of the plant design or major backfitting was necessary.

Lifetime extension is currently being investigated in parallel with the preparation for the necessary changes in the Nuclear Energy Act; revalidation of time-limited aging analyses are being prepared as well.

The operator and Licence Holder (LH) of Borssele NPP is the company EPZ. ZEH Energy B.V. and RWE are shareholders of EPZ, and own 70% respectively 30% of the shares.

6.1(b) Nuclear Power Plant: Dodewaard NPP, in safe enclosure

The Dodewaard NPP was a BWR-type 60 MWe reactor that operated from 1968 until early 1997. In 2002 the LH obtained a licence for 40 years of safe enclosure. In April 2003, the last spent fuel was removed from the site. In April 2005, the construction of the 'safe enclosure' was finished. June 1st, 2005, the 40-years waiting period started under the licence that requires the LH to commence dismantling activities by 2045 at the latest. In 2009, all vitrified waste from reprocessing of Dodewaard's spent fuel was shipped from Sellafield to COVRA. On 12 December 2024 an agreement was signed by which the ownership of the Dodewaard NPP was transferred from the shareholders to the Dutch State. After that, on the same day, the shares of the Dodewaard NPP were transferred from the Dutch State to COVRA. Since that moment COVRA is managing the Dodewaard NPP until it will be dismantled, which is expected to start in 2045.

6.1(c) Research Reactor: High Flux Reactor (HFR)

The HFR is a tank-in-pool type reactor commissioned in 1961 and is located in Petten in the province of Noord-Holland. In the 1980s its reactor vessel was replaced. The owner is the Joint Research Centre (JRC) of the European Commission but since January 2005, the LH and operating organisation is NRG. The HFR is used not only as a neutron source for applied and scientific research, but also for the production of isotopes for medical and industrial applications.

6.1(d) Research Reactor: PALLAS

In 2023 a final construction licence was granted to the PALLAS research reactor: a 20 MWth pool type reactor aiming to replace the HFR as one of the main producers of medical isotopes in Europe. Construction is ongoing.

6.1(e) Research Reactor: Hoger Onderwijs Reactor (HOR)

The HOR is an open pool-type research reactor with a thermal power of 2,3 MWth. It is located in Delft. The owner and LH is the Technical University of Delft. It is operated by the Reactor Institute Delft (RID) which is an entity within the University. The HOR services education and research purposes. Medical applications are getting more and more attention at the HOR and its associated facilities.

The HOR has been upgraded, subsidised by the Dutch government. The associated project is called OYSTER[5]. The installation of a liquid hydrogen cold neutron source was an essential element in the project and improved the flux of long wavelength neutrons by orders of magnitude. In 2021 the reactor was started up again, after the supporting infrastructure for the cold neutron source had been installed. The upgrade of OYSTER was completed in 2024, with the installation of the in-pool-part of the liquid hydrogen cold neutron source.

6.1(f) Plans for new nuclear installations

In the Netherlands there are several initiatives for building new nuclear installations, as further described on the next page.

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[5] OYSTER: Optimised Yield – for Science, Technology and Education of Radiation. To operate the cold neutron source close to the reactor core, a cryogenic infrastructure is needed for heat removal and cooling of the moderator material

6.1.f.1 Government initiative to construct two to four new large scale reactors

In 2021, the Dutch coalition agreement established the policy to pursue the construction of two new large nuclear power reactors. In 2024, this policy was reaffirmed by the new government and strengthened with additional budgetary commitment and an increase to build not two but four new large nuclear power reactors. During 2024 and early 2025, three reactor vendors were invited by the government to perform a feasibility study for the construction of the first two reactors, initially at the site of the Borssele NPP, but other locations were being investigated as well. One of the reactor vendors has withdrawn since then. In early 2025 the ANVS carried out an analysis and concluded that, based on a self-evaluation by the vendors against Dutch nuclear safety regulations and guides, for now there is no reason to assume that one of these designs could not be permitted in the Netherlands. A tendering procedure is foreseen to investigate which vendor could offer the right package. The pre-licensing review and assessment of the chosen design will subsequently be performed by the ANVS.

6.1.f.2 Initiatives to construct SMRs

The government coalition in 2024 decided to also explore the possibility for SMRs in their nuclear new build plans. In 2025 a programme approach started to further investigate the possibilities. Several aspects related to the development of SMRs (e.g. licensing, siting) are part of this programme. The ANVS and the Ministry of I&W participate in this programme initiated by the Ministry of Climate and Green Growth. In this programme the ANVS acts as advisor and has exploratory meetings with interested parties. Aside from that, there is an increased interest in the Netherlands from private parties and regional or local governments to pursue the construction of SMRs. Most of these initiatives focus on larger-sized Light Water SMRs. On its website the ANVS also mentions for which SMR designs early dialogue with and/or preliminary review of private party initiatives is taking place.

6.1.f.3 Advanced reactors and maritime applications

Of special note is the Dutch-French Startup Thorizon which aims to develop a molten salt reactor. In 2024 The French and Dutch regulators started a collaboration for a preparatory review of this design, working jointly to address topics of interest in their design in this early stage of development.

Aside from Thorizon, the Netherlands, as a large maritime state, sees a lot of interest in the application of nuclear power at sea. This concerns specifically in recent years a strong growing interest from companies and harbours in the possibilities of nuclear-powered shipping.

Challenge 2023-02: “Readiness for the developments from the Government plan on nuclear energy and SMRs

- Evaluation of nuclear framework (Ministry I&W)
- Preparing for (pre-licensing of) new NPPs, 2nd LTO of the Borssele NPP, SMRs, ANR (ANVS)”

The evaluation of the nuclear framework was carried out by the Ministry I&W in 2023. This evaluation was also one of the recommendation of the IRRS team that visited the Netherlands in 2023, with the team noting in one of its recommendations that “the government should evaluate and improve, as required, the regulatory framework”. The evaluation carried out by the Ministry of I&W concluded that the current nuclear framework is solid, whilst also noting several points for improvement. These are currently being studied.

The ANVS and the Ministry of I&W participate in the SMR programme, initiated by the ministry of Climate and Green Growth.

The ANVS internal programme NIN (New Initiatives Nuclear) meanwhile was launched in 2024, making sure that all chances, challenges, risks and opportunities between all new initiatives (as described above), as well as the LTO of NPP Borssele, are consistently addressed and that lessons learned are taken into account.

6.2 Overview of safety assessments and other evaluations

6.2(a) General consideration: Long-Term Operation (LTO) and Ageing Management (AM)

History of introduction of AM at nuclear installations

The NPP in Borssele and the two operating RRs all have an age beyond 40 years. Therefore Long Term Operation and Ageing Management are important topics of interest for the Netherlands.

Several elements of nowadays AM used to be part of maintenance, surveillance and periodic testing. Around 1990 the RB stimulated the formal introduction of AM, starting with Borssele NPP. In the same period, the instrument of periodic safety reviews (PSRs) was introduced, also first at the Borssele NPP. In the period 1995-2000 the PSRs were introduced for the RRs. In 2000, AM became a point of attention at the HFR, and ten years later at the HOR.

At the NPP and the HFR, general licence requirements, IAEA standards, PSRs and IAEA missions like OSART, INSARR, AMAT and SALTO were drivers for the gradual development and improvement of AM. In a HFR licence revision (2020) a licence requirement on AM has been included. In June 2022, a CSO mission was carried out at the HFR, which had its follow-up in July 2024. A CSO mission to a RR is the equivalent of a SALTO mission to an NPP. The development of AM at the HOR is also required in its PSR implementation plan. Both RRs continue to develop their AM with the IAEA standard SSG-10 as a basis.

More recently, on the request of the Dutch government, Borssele NPP has started investigating the feasibility of subsequent LTO beyond 2033. Preliminary licensing talks have started to prepare for the licence application for this subsequent LTO. As part of this project, a pre-SALTO mission had been invited to the Borssele NPP, which took place in November 2024.

Topical Peer Review of Ageing Management (TPR AM)

The revised European Nuclear Safety Directive[6] introduces a European system of topical peer review which commenced in 2017 and every six years thereafter. The purpose is to provide a mechanism for EU Member States[7] to examine topics of strategic importance to nuclear safety, to exchange experiences and to identify opportunities to strengthen nuclear safety.

In 2017 all EU Member States and some neighbouring states with reactors with an age above 40 years and thermal power above 1 MW carried out a National Assessment of Ageing Management Programmes (AMPs) of nuclear installations under the auspices of ENSREG. The assessments were conducted according to the WENRA Topical Peer Review Specifications.

The results of the TPR led to only one recommendation for RRs in Europe: make sure that AMPs are being realized.

In the Netherlands the Borssele NPP and RRs HFR in Petten and HOR in Delft participated in the ENSREG-led Topical Peer Review on Ageing Management (TPR-AM). The Netherlands published its first National Action Plan on AM in 2017, the NAcP TPR-AM, which was drafted by the ANVS. The report was updated in 2019 and in spring 2021.

There were a small number of relatively minor improvements requested from Borssele NPP. Refer to the general and country specific reports on the website of ENSREG. Also in the section on Article 14, more information on safety reviews and LTO and AM can be found, related to the Borssele NPP.

The final NAcP was sent to ENSREG in late 2023. For the ANVS three actions remained open. One action, related to gaining information on experience from other countries to inspect, monitor and access structures with limited access was closed with EPZ joining CODAP, a programme to exchange operational

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[6] In 2014, the European Union (EU) Council adopted directive 2014/87/EURATOM amending the 2009 Nuclear Safety Directive to incorporate lessons learned following the accident at the Fukushima Daiichi nuclear power plant in 2011

[7] The process also provides for participation, on a voluntary basis, of States neighbouring the EU with nuclear power programmes

experience, in 2024. Two other actions, related to the improvement of licences for HOR, are expected to be completed by 2026, because they require an amendment of the licence.

6.2(b) Borssele NPP

For assessment and verification of safety of the NPP, also refer to the text on Article 14. In that section more complete information on recent Periodic Safety Reviews and post-stress test actions is given. EPZ has completed all stress test actions.

Since the publication of the previous report to the CNS, the following issues are worth noting:

- In 2023, a PSR was conducted at the Borssele NPP. The identified safety improvements as a result of the PSR are further described in Appendix 4. These should be completed by 2027. The scope of the 2023 PSR did not take into account subsequent LTO (continued operation beyond 60 years) because the request of the government to investigate subsequent LTO came at a very late stage in the 2023 PSR. As a result, the project for subsequent LTO is investigating what this would mean for the identification of possible additional safety improvements.
- The LH participated in the National Report for the second TPR on Fire Protection in 2024. The TPR will be finalised in 2025; results will be shared at the review meeting.
- In 2023 the LH received an IAEA OSART mission. The OSART team identified 11 issues, three of them were recommendations, and eight of them were suggestions. Six good practices were also identified. The most significant issues concerned the use of non-authorised operating aids and documentation, the need to strengthen the radiation protection practices for contamination control, dose planning and the control of radioactive sources, and to improve chemical control practices. The LH has implemented measures to address the issues identified by this OSART mission. A follow-up mission took place in 2025; results will be shared at the review meeting.
- The possibility of a second lifetime extension beyond 2033 is being investigated. As a part of this the LH received an IAEA pre-SALTO mission in 2024. The pre-SALTO team identified 15 issues, with seven of these being suggestions and eight being recommendations. The team also identified two good practices, and four areas of good performance. The most significant issues concerned the need for development and implementation of ageing management programmes for mechanical and electrical components, enhancement of ageing management of civil structures, and an update and implementation of the human resources strategy.
- At the beginning of 2025 the LH received a WANO peer review. In addition the LH is participating in WANO's 'Action for excellence' pilot programme.

6.2(c) HFR RR

At the past review meetings, several Contracting Parties showed an interest in this research reactor. For technical details and a list of planned improvements of the HFR we refer to Appendix 5 of the present CNS report.

Since the publication of the previous report to the CNS, the following issues are also worth noting:

- NRG management has followed an IAEA safety leadership programme and a 'Nuclear Professionalism' workshop was given by NRG to all its employees to improve their understanding of their roles and tasks. New modules are developed and executed on an ongoing basis.
- In 2022 a PSR was conducted at HFR.
- The CSO mission that was scheduled for 2020, was rescheduled to 2022 due to complications resulting from the COVID-19 pandemic. The mission was completed successfully and showed that the HFR organisation has a proper process for asset and ageing management. A follow-up mission took place in 2024. The mission team concluded that eight out of nine recommendations of the 2022 mission had been followed up. The recommendation remaining concerned the better definition and broad implementation of acceptance criteria for systems and components when carrying out maintenance activities. NRG-PALLAS is currently working towards resolving this finding.

6.2(d) PALLAS RR

In 2023 a construction licence was granted for a new reactor aiming to replace the HFR. It was the first time in many years that a licence for the construction of a new nuclear reactor was granted in the Netherlands. The licence granted by the ANVS means that PALLAS is permitted to construct the reactor. To use the reactor another licence is needed for 'commissioning'. The construction licence is not yet final since there is an ongoing appeal case at the Council of State against this licence.

Work on the foundation began in May 2023. A milestone was reached in May 2025 when the construction pit and foundation were completed for the reactor building. The construction site is now being restructured for the start of the construction of the lower section of the reactor. Throughout the construction process the ANVS keeps oversight using a project-based approach. The ANVS also collaborates with ONR to learn from experiences from other Regulatory Bodies. It is foreseen the reactor will be operational from 2030 onwards.

6.2(e) HOR RR

In the reporting period of 8th CNS, the implementation of stress test measures for the HOR was also finished, as reported in the previous national report to the CNS.

Since the publication of the previous report to the CNS, the following issues are also worth noting:

- in 2024 the follow-up of the INSARR mission of 2021 was performed at the HOR. The IAEA team concluded that 19 of 22 recommendations had been either fully implemented or implemented with minor actions remaining. All five suggestions had been considered by the HOR with significant actions having been taken to implement them. The three remaining recommendations pertain to the need for continued enhancement of the safety analysis through a reassessment of the fuel channel blockage scenario, an update of the area classification and zoning system for radiological protection, and the redefinition of maintenance, periodic testing, and inspection requirements as part of the Operational Limits and Conditions (OLCs) during the extended reactor shutdown period.
- In 2024 the Cold Neutron Source was installed and commissioned with a successful reactor restart after nearly a year of work (Project OYSTER).

6.3 Summary of Responses to Applicable Challenges and Suggestions

The Nuclear Framework has been evaluated by the Ministry of I&W. Meanwhile, internally at the ANVS the New Initiatives Nuclear Programme (NIN)[8] has been launched. The ANVS also takes part in the SMR programme, initiated by the Ministry of Climate and Green Growth.

6.4 Summary of Significant Changes Since Previous Report

- Lifetime extension for Borssele NPP is currently being investigated.
- Licensing of PALLAS RR in 2023 and start of construction of pit and foundation.
- Completion of OYSTER project at HOR RR in 2024.
- Since 2024 COVRA holds the shares for the NPP Dodewaard.
- Preparations by the ANVS for new initiatives:
    - ANVS and Ministry of I&W participation in SMR programme, initiated by Ministry of Climate and Green Growth;
    - Further investigation of the ANVS into maritime nuclear applications;
    - In 2024 the ANVS and the French regulator started a collaboration for a preparatory review of the Thorizon design (molten salt thorium reactor);

[8] Please refer to: Programme New Initiatives Nuclear (NIN) | Publication | Authority for Nuclear Safety and Radiation Protection for a further description on the programme.

  - Review of self-evaluation by three vendors of large power reactors against Dutch regulations and guides by the ANVS in early 2025;
  - Start of NIN programme within the ANVS in 2024 to address these new developments.

- Various (follow-up) missions carried out at nuclear installations in the Netherlands:
  - INSARR mission at HOR in 2021, with a follow-up in 2024;
  - PSR mission at HFR in 2022;
  - CSO mission carried out at HFR in 2022, with a follow-up in 2024;
  - The final National Action Plan (NAcP) of the TPR Ageing Management was sent to ENSREG in late 2023;
  - PSR mission at NPP Borssele in 2023;
  - OSART mission carried out at NPP Borssele in 2023, with a follow-up in 2025;
  - Pre-SALTO mission at NPP Borssele in 2024;
  - TPR Fire Protection was carried out in 2024;
  - WANO peer review carried out at NPP Borssele in 2025.

6.5 Notable achievements

- Launch of the ANVS internal programme NIN (New Initiatives Nuclear) in 2024 to facilitate new initiatives as well as the LTO of NPP Borssele, while maintaining a healthy balance with current tasks and responsibilities.

6.6 Future Focus

- Continuing preparations by the ANVS for new initiatives concerning conventional NPPs, SMRs and other new technologies such as molten-salt reactor (project Thorizon) and maritime nuclear applications, as well as preparations for the LTO of NPP Borssele.

Article 7. Legislative and regulatory framework

7.1 Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

7.2 The legislative and regulatory framework shall provide for:

i. the establishment of applicable national safety requirements and regulations;

ii. a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;

iii. a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences.

The Kingdom of the Netherlands fulfills the obligations of Article 7.

7.1 Legislative and regulatory framework

7.1(a) Overview of the legal framework

7.1.a.1 Legal framework - structure

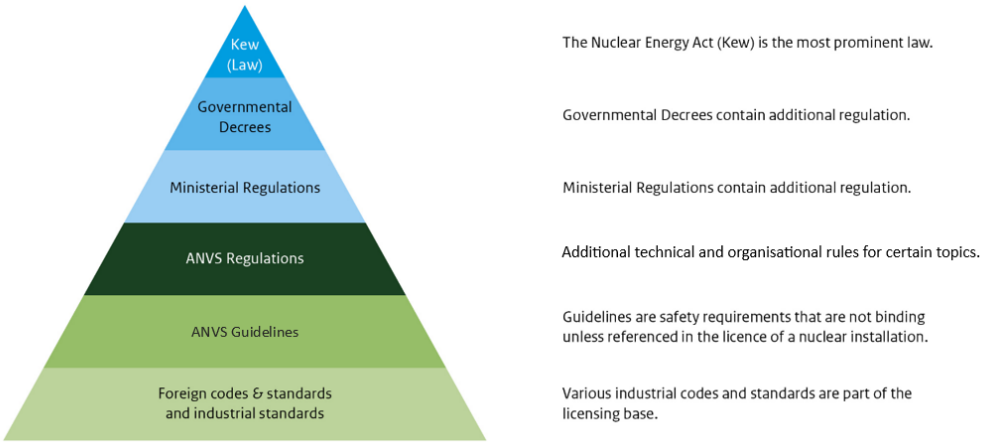
The legal framework in the Netherlands with respect to nuclear installations can be presented as a hierarchical structure. Refer to the diagram in Figure 2.

In addition to the levels shown in this figure, there are international conventions and other legal instruments related to nuclear safety that also apply. Refer to section 7.1(c) for more information.

The ANVS is authorised to issue 'ANVS – Regulations'. These are issued if:

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

Figure 2 Simplified representation of the hierarchy of the legal framework



7.1.a.2 Governmental framework

The Netherlands are 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 is called the States General and 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.

7.1.a.3 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 (or Ordinances). Based on its expertise and in relation to its other statutory tasks, the competent regulatory authority, i.e. the Regulatory Body, can advise on the legal framework, or updates thereof, concerning nuclear safety, radiation protection or related subjects.

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[9] 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

[9] 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

decide how to use this input. Governmental Decrees do not require a vote in Parliament. For legislation related to nuclear safety the Minister of I&W is the responsible minister, with the State Secretary having nuclear safety in his/her portfolio.

Ministerial regulations, the preparation of which is delegated to a minister, are also not submitted to Parliament for a vote.

7.1.a.4 Governmental entities having responsibility in the regulatory framework

- The Ministry of I&W is responsible for the preparation of policy, laws and regulations with respect to nuclear safety, security and radiation protection. This task is performed by the entity 'Nuclear Safety and Radiation Protection' which resides within the Environmental Safety and Risks Directorate. The Minister of I&W is politically responsible for the functioning of the ANVS and has final responsibility for the effective operation of the ANVS.
- The Ministry of Social Affairs and Employment (SZW[10]) has tasks in the area of protection of the safety of workers against exposure to radiation and is responsible for policy, laws and regulations regarding radiation expertise.
- The Ministry of Health, Welfare and Sports (VWS[11]) has tasks in the area of protection of patients against exposure to radiation and is responsible for the protection of public health against the unwanted effects of ionising radiation on product and food safety.
- The Dutch State Supervision of Mines (SodM[12], part of the Ministry of Climate Policy and Green Growth, KGG[13]) oversees the safe and environmentally sound exploration and exploitation of natural resources like natural gas and oil.
- The Netherlands Food and Consumer Product Safety Authority (NVWA[14]) monitors food and consumer products to safeguard public health and animal health and welfare. The NVWA controls the whole production chain, from raw materials and processing aids to end products and consumption. The NVWA is an independent agency part of the Ministry of Agriculture, Fisheries, Food Security and Nature[15] and a delivery agency for the Ministry of Health, Welfare and Sport.
- The Inspectorate of the Ministry of I&W (ILT[16]) has general supervision responsibilities for amongst others the compliance with the Nuclear Energy Act and the requirements of modal transport regulations.
- The Ministry of Defence has its inspectorate military healthcare (IMG[17]) for overseeing a healthy and safe work environment for its civilian and military staff. Its scope includes applications of ionising radiation and accounting for the use of radioactive sources within the military.

Most entities of the above mentioned entities employ only a limited number of staff for the Nuclear Energy Act-related tasks.

A cooperation agreement for Radiation Protection (signed in 2017) was set up between the ANVS and the entities mentioned above. The cooperation agreement describes the interaction, communication and cooperation between these entities.

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[10] Dutch: 'Ministerie van Sociale Zaken en Werkgelegenheid', SZW

[11] Dutch: 'Ministerie van Volksgezondheid, Welzijn en Sport', VWS

[12] Dutch: 'Staatstoezicht op de Mijnen', SodM

[13] Dutch: 'Ministerie van Klimaat en Groene Groei', KGG

[14] Dutch: 'Nederlandse Voedsel en Waren Autoriteit', NVWA

[15] Dutch: 'Ministerie van Landbouw, Visserij, Voedselzekerheid en Natuur', LVVN

[16] Dutch: 'Inspectie Leefomgeving en Transport', ILT

[17] Dutch: 'Inspectie Militaire Gezondheidszorg', IMG

7.1.a.5 Responsible authority

In the present report, the Regulatory Body (RB) is the entity designated by the government as having legal authority for conducting the regulatory processes, including issuing authorisations, supervision and enforcement, and thereby supervising nuclear safety security and safeguards, radiation protection, radioactive waste management and transport safety.The ANVS is independent in its regulatory decision making on radiation protection, nuclear safety and security in the Netherlands.

Refer to the text on Article 8 for more information on the RB and its organisation and position in the regulatory framework.

7.1(b) Primary legislative framework: laws

7.1.b.1 Nuclear Energy Act

The basic legislation governing nuclear activities is contained in the Nuclear Energy Act ('Kernenergiewet' or 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. The Nuclear Energy Act has a comprehensive character: all uses of ionising radiation and all of the requirements to protect against it are regulated exclusively by this Act and by legislation based on it. The more detailed legislation is provided by associated Governmental Decrees and Ministerial Regulations. These continue to be updated in the light of ongoing developments.

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

- The protection of people, animals, plants and property;
- The security of the State;
- The 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, fissionable materials are defined as materials containing at least 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.

As of February 16th 2022 a modification of the Act, article 17, sub 4 came into force. This is in reaction to findings of the Aarhus Convention Compliance Committee in 2018. The modification aims at broadening the public participation in case of change of the design lifetime of a nuclear installation.

An extensive body of legislation is based on the Nuclear Energy Act. This includes Governmental decrees, ministerial regulations, the regulations issued by the ANVS, and a number of general operating decisions. These include, but are not limited to:

- **Nuclear Facilities, Fissionable Materials and Ores Decree (Bkse[18]):** The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse regulates all practices involving fissionable materials, including spent fuel, and nuclear facilities (including licensing). As of January first 2025, the Decree also regulates the main security principles for nuclear installations and fissile materials, partially replacing the Nuclear Facilities and Fissionable Materials (Security) Regulation, which has been repealed. The amended Decree now outlines the main elements of the legal framework for nuclear pressure equipment, including improved delegation provisions for lower regulations. It prohibits the use of nuclear pressure equipment, unless it has been approved according to established requirements. These requirements, set by the ANVS Regulation on Nuclear Pressure Equipment, Security and Decommissioning, largely refer to inspection standards from internationally recognised

[18] Dutch: Besluit kerninstallaties, splijtstoffen en ertsen, Bkse

technical documents. Currently, this Decree is being evaluated to respond to developments with regard to new reactor technologies, such as SMRs and advanced reactors (ARs).

- **Fissionable Materials, Ores and Radioactive Materials Transport Decree (Bvser[19]):** The licensing system for the shipment of these materials has been elaborated in the Fissionable Materials, Ores and Radioactive Substances (Transport) Decree.
- **Decree on Basic Safety Standards for Radiation Protection (Bbs[20]):** the Decree on Basic Safety Standards for Radiation Protection has been in force since 6 February 2018. The goal of this Decree is to protect the public, the environment, employees and patients against the adverse effects of ionising radiation. This complies with the 2013/59/EURATOM directive. The requirements set out in the Decree have been elaborated, in the associated regulations, published January 2018.
    - **Regulation on Radiation Protection for Occupational Exposure:** Responsibility for the protection of employees from occupational exposure to radiation rests with the Ministry of Social Affairs and Employment. Specific topics have been further elaborated.
    - **Regulation on Radiation Protection for Medical Exposure:** The Bbs chapter 8 deals with medical exposures. This decree elaborates on a number of specific subjects.
    - **Regulations on Basic Safety Standards for Radiation Protection:** The Regulation on Basic Safety Standards for Radiation Protection contains provisions for the elaboration of the Decree on Basic Safety Standards for Radiation Protection. These Regulations contain rules and appendices with technical and other requirements for implementation.
- **Ministerial Regulation on Nuclear Safety for Nuclear Installations (MR NV[21]):** The regulations extend to implementation of the EURATOM Directive for the nuclear safety of nuclear facilities (Directive 2009/71/EURATOM, as amended by Directive 2014/87/EURATOM). The regulations provide the necessary community framework for maintaining the nuclear safety of nuclear facilities and for promoting continuous improvement.
- **Nuclear Pressure Equipment Regulation[22]**: This Ministerial Decree, as amended on January 1, 2025, now only includes provisions for other pressure equipment, not specifically designed for nuclear use in such facilities, that could cause the release of radioactivity in the event of a malfunction.
- **ANVS-Regulation on Nuclear Pressure Equipment, Security and Decommissioning[23]:** The provisions in this regulation concern more technical and organisational provisions regarding nuclear pressure equipment, the security of nuclear facilities and fissionable materials, and decommissioning, which further elaborate on the regulations from other decrees.

7.1.b.2 General Administrative Act (Awb)

The General Administrative Act (Awb[24]) is the body of law that governs the activities of administrative agencies of government and the interaction of the public in the procedures (i.e. objections and appeals). The Awb applies to virtually all procedures 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. Most of the licence decisions with regard to nuclear facilities are prepared with the so-called 'uniform public preparation procedure[25]'. According to this procedure, draft decisions

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

[20] Dutch: Besluit basisveiligheidsnormen stralingsbescherming, Bbs

[21] Dutch: Ministeriële Regeling Nucleaire Veiligheid kerninstallaties, MR NV

[22] Dutch: Regeling nucleaire drukapparatuur

[23] Dutch: ANVS-Verordening nucleaire drukapparatuur, beveiliging en ontmanteling

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

[25] Dutch: 'Uniforms openbare voorbereidingsprocedure'

need to be published in the Dutch Government Gazette ('Staatscourant'), and in the national and/or local press. Documents provided with an application for a licence are to be made available for inspection by members of the public. All members of the public are free to lodge written 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. Members of the public that have expressed views to the draft decision are as stakeholders 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. Ministerial regulations and ANVS regulations have to be published in the Government Gazette. Public participation is also possible via internet consultation.

7.1.b.3 Environment and Planning Act (Omgevingswet)

On the 1st January 2024, the new Environment and Planning Act came into force, replacing the previous Environmental Protection Act and Environmental Impact Assessment Decree. The Environment and Planning Act brings together the set of rules for the living environment in one overarching law. For example, the Water Act, the Environmental Permitting (General Provisions) Act and the Environmental Management Act are integrated into the Environment and Planning Act. The licensing processes and monitoring largely remained the same.

The Environment and Planning Act introduced some changes for the ANVS, for example the procedure for an EIA or an EIA judgement is simplified.

Environmental Impact Assessments (EIAs)

According to the Environment and Planning Act and associated Environmental Decree, the licensing procedure for the construction of a nuclear facility includes a requirement to draft an Environmental Impact Assessment (EIA) report. In certain circumstances, an EIA is also required if an existing plant is modified. In case of modification or extension of a plant, this modification or extension should be on a case-by-case basis subject to an assessment on the basis of the significance of its environmental impact. This can lead to the conclusion that an EIA is required. Overall, with the introduction of the Environment and Planning Act, licences for (the modification of) nuclear facilities are subject to an EIA assessment in more cases. In any case, an assessment on the basis of the significance of the environmental impact is required in situations involving:

- A change in the type, quantity or enrichment of the fuel used;
- An increase in the release of radioactive effluents;
- An increase in the on-site storage of spent fuel;
- Decommissioning;
- Any change in the conceptual safety design of the plant that is not covered by the description of the design in the safety analysis report;
- Change of the design life time of a nuclear installation with more than five years.

The Environment and Planning Act and associated Environmental Decree state that an independent Commission for EIAs, named 'Commissie voor de m.e.r.' (Cmer) can be asked to advise on 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.

Water activity

The Environment and Planning Act also replaced the Water Act (Waterwet). For a proposed activity for nuclear facilities, in addition to the Nuclear Energy Act licence, a licence under the Environment and Planning Act may be required from the water manager (water board or Rijkswaterstaat), if there are non-

radioactive direct discharges into surface water. In that case, coordination of the licensing procedures may be required.

Construction activity

The Environment and Planning Act further replaced the Environmental Permitting Act (Wabo). A proposed activity for which a licence (change) is required under the Nuclear Energy Act can sometimes also be considered a construction activity. In addition to a Nuclear Energy Act licence, an environmental licence (i.e. building licence) under the Environment and Planning Act is also required for this. This building licence is issued by the municipality. If this situation occurs, a coordination arrangement applies to building licences for nuclear facilities in the sense that the building licence does not enter into force until after the Nuclear Energy Act licence has entered into force and vice versa.

Flora and fauna activity and Natura 2000 activity

For a proposed activity for nuclear facilities, in addition to the Nuclear Energy Act licence, a licence under the Environment and Planning Act may sometimes be required in order to protect nature reserves (including against nitrogen), plant and animal species. The ANVS may decide, in consultation with the Provincial Executives as the competent authority for these licences, to coordinate the processing of the related licence applications.

7.1.b.4 Open Government Act ('Wet Open Overheid', Woo)

Under the Dutch Open Government Act (Woo), as a basic principle, information held by public authorities is public, excluding information covered by the exceptions enumerated in the Act in its Article 5.1.[26] The act requires authorities to actively disclose 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 4.1 of the Woo, any person can request information held by public authorities or companies carrying out work for a public authority.

7.1.b.5 Act on the liability for nuclear accidents ('Wet Aansprakelijkheid Kernongevallen', Wako)

In order to apply the Paris convention on nuclear third party liability and Brussels supplementary convention, the Dutch act on the liability for nuclear accidents implements the parts of these conventions, for which more detailed rules of the contracting parties are necessary. It concerns for instance:

- The maximum amount for which operators of nuclear installations are liable.
- A specification of the kind of financial security which is required.

Some options which the convention leaves to the contracting parties are adopted in the act. For instance the possibility to establish a lower liability for nuclear installations of a low risk nature.

The maximum liability of operators of nuclear installations has been set at €1.2 billion. The act also contains some provisions which offer extra financial protection for the public, apart from the safeguards already offered by the conventions. The most important of these provisions is the State Guarantee up to €3.2 billion and a possibility to charge a fee on installations for this guarantee.

The maximum liability of €1.2 billion applies to Borssele NPP. For all other nuclear facilities subject to the Wako, a lower liability has been set. The State Guarantee in those cases is also lower, with a maximum of €1.5 billion.

7.1.b.6 Safety Region Act ('Wet veiligheidsregio's', Wvr)

The Safety Regions Act seeks to achieve an efficient and high-quality organisation of the fire services, medical assistance and crisis management under one regional management board. This is in no way a

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

break in trend with practices existing before. Past regulations and legislation already required the municipalities to form regions and the Disasters and Major Accidents Act (Wet rampen en zware ongevallen - Wrzo) assumed that such regions had been established. The Safety Regions Act is thus continuing on the basis of existing structures.

7.1(c) Ratification of international conventions and legal instruments related to nuclear safety

In addition to the CNS, 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.

- *Liability:* The Netherlands is party to a series of UN treaties on liability, including the Paris Convention[27] and supplementing convention to the Convention of Paris, established in Brussels, and the joint protocol concerning the application of the Vienna Convention and the Paris Convention.
- *Non-proliferation*: the Netherlands is party to the 'Treaty on the Non-Proliferation of Nuclear Weapons' (NPT), 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[28].
- *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[29].
- *Physical protection:* The Netherlands is party to the Convention on Physical Protection of Nuclear Material and Nuclear Facilities[30].
- *Environmental impact*: The Netherlands is party to the Espoo Convention on Environmental Impact Assessment(EIA) in a Transboundary Context.
- *Public Participation:* The Netherlands is party to the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters.

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 implemented Council Directive 2009/71/EURATOM of 25 June 2009 on nuclear safety in its national legislation force[31] 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.

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[27] 'Paris Convention on Third Party Liability in the Field of Nuclear Energy'

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

[29] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, (JC)

[30] 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

[31] 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 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 changes in the installation ('continuous improvement'). Also, the regulation prescribes inter alia that:
    - LHs should give sufficient priority to nuclear safety systems;
    - LHs must provide adequate human and financial resources to meet the obligations on the nuclear safety of a nuclear installation;
    - All parties, including the LH, are required to provide a mechanism for educating and training their staff responsible for the safety of nuclear plants to meet the expertise and competence in the field of nuclear safety to be maintained and developed.
- Post-Fukushima, the EU amended[32] its NSD in 2014. The amended Directive was developed considering various reviews, and reinforces several provisions of the 2009 NSD, such[33] as:
    - 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 power plants to be conducted at least once every 10 years.
    - Increases transparency by requiring operators of nuclear power plants to release information to the public, both in times of normal operation and in case of incidents.

  The implementation of the amended Nuclear Safety Directive in Dutch legislation was prepared in 2016 and was completed in 2017[34] and resulted in a new Ministerial Decree on Nuclear Safety (MR-NV).
- The Netherlands has implemented 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), the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) and in the Decree on the import, export, and transit of radioactive waste and irradiated fissile materials. The Netherlands has published the required 'National Programme' according to the definition provided by this Directive in 2016[35]. This is out of the scope of the present report to the CNS. More information on implementation of this Directive will be reported in national reports for the 'Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management'.
- The Netherlands has implemented 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.

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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)

[32] 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'

[33] 2015, Report of ENSREG, HLG_p(2015-31)_145.

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

[35] Nationaal programma radioactief afval | Publicatie | Autoriteit NVS

7.1(d) Special agreements

7.1.d.1 Special agreements - the 2006 covenant

Borssele NPP has a licence unlimited in time. In 2006 a covenant was signed by the operator and owners of the plant and the government, stating that the plant shall cease operation no later than 31 December 2033. Notwithstanding this covenant the requirements of the Nuclear Energy Act and the licence shall be complied with at all times. The final date of electricity production, was also included in the Nuclear Energy Act.

In 2024 the new government coalition presented its plans for the coming years. Part of this was the pursuit of a strong reduction in greenhouse gas emissions. As part of this, there are plans to build up to four new nuclear power plants and to extend the operating life of the Borssele nuclear power plant.

To extend the operating life of the Borssele NPP, article 15a of the Nuclear Energy Act has to be amended, as well as the covenant. When the covenant is amended, a decision must be taken as well about the Borssele Benchmark Committee. All parties that have signed the covenant must cooperate to adjust or cancel the covenant.

7.1.d.2 Special agreements – reprocessing spent fuel

In July 2006 new French legislation entered into force, which prescribes that a return-scheme for the radioactive waste has to be formalised at the moment the spent fuel is sent to France.

In response a (new) bilateral agreement between the governments of the Netherlands and France was concluded, establishing a return-scheme for the spent fuel under the reprocessing contract that was valid at the time. In 2009 the bilateral agreement between France and the Netherlands was signed[36]. A new treaty was signed by the Republic of France and the Kingdom of the Netherlands on April 20, 2012, regulating for Dutch spent fuel (SF) produced after 2015, its receival by Areva NC[37], in France, its reprocessing and the return of radioactive wastes from reprocessing to the Netherlands before 31 December 2052. The treaty entered into force January 1st 2014[38]. On 21 March 2022, a new assessment framework to allow acceptance of alternative packages of reprocessed fuel was sent to parliament. The assessment framework came into force in January 2023. Driving force behind this new policy was a request of the Borssele NPP to allow more flexibility in the packages of reprocessing waste returning to the Netherlands.

7.2 Provisions in the legislative and regulatory framework

7.2(a) National safety requirements and regulations

This section describes the regulatory framework, that is sitting below the top-level (laws) of the legal hierarchy. Refer to section 7.1(a) for the complete overview of the framework and the processes for establishing the elements of the framework. In short, the following categories will be discussed in this section:

- Governmental Decrees (Dutch: 'Besluiten').
- Ministerial Decrees (Dutch: 'Ministeriële regelingen').
- ANVS regulations, These are issued if:
    - Rules are needed on technical or organisational issues;
    - Rules are needed, relevant to nuclear safety, radiation protection and security, and;

[36] Treaty Publications of the Netherlands (Tractatenblad), 2009, No. 41

[37] AREVA NC: AREVA Nuclear Cycle, was a subsidiary of the AREVA Group. Since the restructuring of AREVA, these activities are part of Orano. Orano provides services in all stages of the uranium fuel cycle

[38] Treaty Publications of the Netherlands (Tractatenblad), 2012, No 93

  - Governmental Decrees or Ministerial Decrees refer to rules to be provided in ANVS Regulation.

- Dutch Safety Requirements like amended IAEA Requirements or Guides.
- Guidelines on various issues ('Handreikingen'); non-binding documents published by the ANVS to aid LHs to meet the RB's expectations.
- Other adopted foreign and international codes and standards.

7.2.a.1 Governmental Decrees

Several Decrees have been mentioned in section 7.a(a) in association with the Nuclear Energy Act. In this section a few are described to somewhat more detail.

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. Refer also to 7.1.b.3.

Reimbursement Decree

Current regulation already provides for limited reimbursement of the RB for the costs of oversight and licensing, carried out by the RB. The LHs pay an annual fee and on top of this there are fees for individual licensing activities. However, currently only a limited fraction of the annual budget of the RB is collected by the Ministry of I&W, that finances the RB. The objective is to increase this fraction in the coming years. Therefore new reimbursement regulation[39] was drafted. In the new Decree the financial contribution from the nuclear installations was increased to 22 % cost coverage. The associated Decree entered into force on January 1st 2014. In 2016/2017 the reimbursement regulation and its application was evaluated. It was decided that more information was needed on the actual costs and efforts associated with oversight and licensing. In 2018 a pilot project started regarding hour registration, which continued in 2019. In 2021 the ANVS provided their advice[40] to the policy department DGMI on what subjects to revise the Decree. Currently DGMI is in the process of making changes to this piece of regulation.

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 and radiation-emitting devices, and prescribes general rules for their application.

The Netherlands has implemented Council Directive 2013/59/EURATOM[41], 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 came 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").

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[39] Dutch working title: 'Besluit Vergoedingen Kernenergiewet'

[40] Advisory report "Revision of the Nuclear Energy Act Fees Decree" of the 17th of February 2021

[41] 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

- 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). 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.

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 ionising 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 15.c.3 and 31), the Bbs Decree and also 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. NPPs, isotope laboratories, sealed sources, X-ray machines, industries, etc.), 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.

More on radiation protection and the Bbs can be found in the texts on Article 15 (sections 15.1 en 15.2).

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

Bkse and licensing

The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) regulates all practices involving fissionable materials 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 nuclear reactor, and associated requirements. According to article 6 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 description of the installation, including the equipment to be used in it, the mode of operation of the installation and the equipment, a list of the names of the suppliers of those components which have a bearing on the assessment of the safety aspects, and a specification of the installation’s maximum thermal power;
- A statement of the chemical and physical condition, the shape, the content and the degree of enrichment of the fissionable materials which are to be used in the installation, specifying the maximum quantities of the various fissionable materials that will be present at any one time;
- A description of the way in which the applicant intends to manage the relevant fissionable materials after their use;
- A description of the measures to be taken either by or on behalf of the applicant so as to prevent harm or detriment or to reduce the risk of harm or detriment, including measures to prevent any harm or detriment caused outside the installation during normal operation, and to prevent any

harm or detriment arising from the Postulated Initiating Events (PIEs) referred to in the description, as well as a radiological accident analysis concerning the harm or detriment likely to be caused outside the installation as a result of those events (safety analysis report);

- A risk analysis concerning the harm or detriment likely to be caused outside the installation as a result of severe accidents (Probabilistic Safety Analyses).
- A statement of the insurance or other financial security that the applicant shall have and maintain to satisfy the Wako, including all relevant details.

Bkse and decommissioning

Bkse includes legislation on decommissioning and financial provisions for the costs of decommissioning. An important part of this legislation was based on the WENRA[42] Safety Reference Levels on decommissioning.

Bkse requires the LH 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. Bkse specifies the minimum requirements on the content of the decommissioning plan, which are regulated further in the Shutdown and decommissioning Regulation (Rboni). The decommissioning plan serves as the safety-basis for all the activities carried during the decommissioning phase, and it provides the basis for the financial provisions for the decommissioning costs.

Furthermore, the LH of a research reactor or nuclear power plant is required to have a financial provision to cover the costs of decommissioning, which will have to be updated and approved by the authorities (i.e. the Ministers of 'Infrastructure and Water Management and of Finance) every time the decommissioning plan is updated or when requested by these ministers. Upon approval, the authorities will assess whether the financial provision offers sufficient security that the decommissioning costs are covered at the moment of decommissioning.

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

- 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.

Bkse and risk criteria for incidents and accidents

The Netherlands has a policy[43] on tolerance of risks posed by any hazardous activity and including also nuclear power stations. This policy has been formulated independently of the Nuclear Safety Requirements (the 'NVRs') and is primarily incorporated in the Bkse Decree.

The basis and application of the regulations are discussed in some detail in Appendix 1, which includes more detailed references to official documents (Acts, Decrees, etc.). As far as the radiological hazard is concerned, the regulations can be seen as implementing the IAEA Fundamental Safety Standards (IAEA

[42] Western European Safety Regulators Association, WENRA

[43] Formulated by the former Ministry of VROM, for the scope of the CNS, the predecessor of the Ministry of Infrastructure and Water Management

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 LH 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.

Bkse and Risk criteria (1): Individual risk

In accordance with the probabilistic acceptance criteria for individual mortality risk as laid down in Bkse, the maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per annum for all sources together and 10^{-6} per annum for any single source. These numerical criteria were developed as part of general Dutch risk management policy in the late eighties of the 20th century. Based on an average annual mortality risk of 10^{-4} per annum for the least sensitive (highest life expectancy) population group (i.e. youngsters around 12 years old) from all causes, it was decided that any industrial activity should not add more than 1% to this risk. Hence, 10^{-6} per annum was selected as the maximum permissible additional risk per installation. Furthermore, it is assumed that nobody will be exposed to risk from more than 10 installations and the permissible cumulative individual mortality risk is therefore set at 10^{-5} per annum.

Bkse and Risk criteria (2): Group or societal risk

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

Bkse and Risk criteria: taking account of countermeasures

In demonstrating compliance with the risk criteria, it is required to assume in the supporting analysis that only the usual forms of mitigating measures are taken (i.e. action by fire services, hospitals, etc.). Although the emergency preparedness and response organisation may take special measures like evacuation, iodine prophylaxis and sheltering, these are disregarded in the Probabilistic Safety Analysis (PSA). In fact it is assumed that any countermeasure will never be 100% effective. It is more realistic to expect that a substantial part of the population will be unable or unwilling to adopt the prescribed countermeasure(s). The PSA results used to demonstrate compliance with the risk criteria, therefore need to reflect this more conservative assumption[44].

See Appendix 1 or a discussion of the abovementioned dose- and risk criteria and their background.

7.2.a.2 Ministerial Decrees ('Ministeriële Regelingen, MR')

Ministerial Decrees are issued by the Minister of I&W and are mandatory for all nuclear installations and activities. In this section, only a small selection of these Decrees relevant in the context of the CNS are discussed.

Ministerial Decree on (nuclear) pressure equipment

This Ministerial Decree entered into force on 1 January 2008 and addressed the qualification of nuclear pressure equipment. The Ministerial Decree, as amended on January 1, 2025, now only includes provisions for other pressure equipment, not specifically designed for nuclear use in such facilities, that

[44] However, for the sake of interest, the PSA results of the Dutch NPP show both situations: with and without credit being given for countermeasures

could cause the release of radioactivity in the event of a malfunction. Most of its previous contents are now laid down in the ANVS Regulation on Nuclear Pressure Equipment, Security and Decommissioning.

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 'MR-NV').

7.2.a.3 Regulations and guides issued by the Regulatory Body

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

The Regulatory Body has now issued two regulations as part of the national legislative framework. The national legislative framework establishes the generic nuclear safety and radiation protection objectives applicable to all nuclear installations. The regulations allow for more detailed technical and organisational provisions regarding nuclear safety and radiation protection, as long as it has a basis in the Nuclear Energy Act, and/or Government Decree and/or Ministerial Regulation. Despite these regulations, licences remain a primary instrument for specifying detailed requirements. Given the Netherlands' small yet diverse nuclear programme, specific requirements continue to be outlined within the licences, tailored to the unique characteristics of each installation. These licences may reference the Nuclear Safety Rules (NVRs) as well as other nuclear codes and standards. Examples of regulations and guidelines as issued and endorsed by the ANVS are listed below.

Regulation on Basic Safety Standards for Radiation Protection[45]:

The ANVS Regulation on Basic Safety Standards for Radiation Protection entered into force on July 1 2023 and contains provisions for the elaboration of the Decree on Basic Safety Standards for Radiation Protection. The Regulation contains rules and appendices with technical and other requirements based on and elaborating on regulations in the Decree on Basic Safety Standards for Radiation Protection.

Regulation on Nuclear Pressure Equipment, Security and Decommissioning[46]:

This ANVS Regulation entered into force on January 1 2025, and expands on topics covered in Ministerial Regulations, specifically addressing technical and organisational requirements for nuclear pressure equipment, the security of fissile materials and facilities, and decommissioning. Given the specialised nature of nuclear pressure equipment, the security of facilities and other locations where activities involving fissile materials and ores are conducted, and decommissioning, it was decided to establish separate ANVS Regulation on Nuclear Pressure Equipment, Security, and Decommissioning. This regulation exists alongside the existing ANVS Regulation on Basic Safety Standards for Radiation Protection.

Nuclear Safety Rules (NVRs) and upcoming changes

The NVRs are IAEA Safety Requirements and Safety Guides that have been adapted to the Dutch situation. The Nuclear Safety Rules (Dutch: 'Nucleaire VeiligheidsRegels', NVRs) are legally binding for an installation or nuclear facility, as far as they are referenced in their licences through a licence condition. This mechanism allows the ANVS to enforce the NVRs. The practice of including requirements in the licence is suitable for a country like the Netherlands with a very small number of different nuclear facilities and only one operating NPP. Currently NVRs are only applied to the NPP.

Recently the ANVS has studied ways to further implement IAEA Safety Requirements and Safety Guides in the regulatory framework, as well as WENRA Safety Reference Levels (RLs). It was decided that in

[45] Dutch: ANVS-verordening basisveiligheidsnormen stralingsbescherming
[46] Dutch: ANVS-Verordening nucleaire drukapparatuur, beveiliging en ontmanteling

future, IAEA Safety Requirements will be attached to the licence by referring to them in the licence conditions. The timing of the process will be determined by the licensing procedures.

Relevant IAEA Safety Guides and WENRA RLs will be implemented by reference in guides ('Handreikingen'), issued by the ANVS.

This is also line with recommendations made during the 2023 IRRS mission to the Netherlands which stated that the ANVS "should further develop regulations and guides to be consistent with current IAEA safety standards". This recommendation was made with the review team noting that the requirements in some areas of the regulatory framework were of a very general nature, or were not established.

VOBK

VOBK[47] are the Guidelines ('ANVS Handreiking') on the Safe Design and Operation of Nuclear Reactors - Safety Guidelines for short. These Guidelines provide new reactor licence applicants with detailed insight into what the ANVS considers to be the best available technology. It is applicable to existing nuclear power reactors as far as reasonably achievable (e.g. as a reference during a Periodic Safety Review, PSR) and in line with the objective of continuous improvement. An annex to the VOBK is dedicated to Research Reactors. The application of this annex to new and existing research reactors will also have a graded approach. The VOBK is currently being evaluated and revised. The ambition of the government to build new nuclear powerplants and potentially also SMRs is the main driver behind this revision. The new version of the VOBK is expected at the end of 2025, and will be referred to at the review meeting.

7.2.a.4 Other foreign and international codes and standards

Adopted foreign nuclear codes and standards

The experience with the IAEA-Standards has been generally positive. 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. Therefore in addition nuclear codes and standards of specific countries often are 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.

Industrial standards

The Safety Guides in the NVR series give guidance on many specific items. However, they do not cover 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.

7.2(b) System of licensing

Procedures

The Nuclear Energy Act stipulates (in its Article 15, sub b) that a licence must be obtained to construct, commission, operate, significantly modify or decommission a nuclear power plant or another 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 also required in a number of cases (identified in the Decree Bbs) for the preparation, transport, possession, import or disposal of radioactive material.

The procedures to obtain a licence under the Nuclear Energy Act (and other acts), follow the procedures specified in the General Administrative Act (Awb). The licensing and the requirements that are to be met by licence applications for nuclear installations, are governed by the Decrees Bkse and Bbs. The licensing 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

[47] Dutch: Veilig Ontwerp en het veilig Bedrijven van Kernreactoren, VOBK, published October 2015

respond to them with careful reasoning. If the reply is not satisfactory, the decision of the RB can be challenged in the administrative court. Refer to Figure 3 for an overview of the process.

With a licence application regarding nuclear installations, there are many cases for which it is compulsory to conduct an Environmental Impact Assessment or EIA (Dutch: milieu-effect rapportage, m.e.r.). Examples are: construction of a nuclear installation, increase of its power (reactors), increase of storage capacity (SF and waste storage facilities), increase of processing capacity (enrichment), or decommissioning of the installation. This does not apply to nuclear research reactors with a thermal power lower than 1 kW.

The Netherlands has a permanent commission, the Commission for the Environmental Assessment ('Commissie voor de m.e.r.', Cmer) that advises the competent regulatory authority on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear installations.

The licences for nuclear installations are granted for an indefinite period. Modifications of licences are needed if the installation or the activity as described in the Safety Report (SR) is changed. For example modifications have taken place in the past related to the implementation of safety improvements after the PSR (several nuclear installations), and for Borssele NPP modification of the fuel enrichment, fuel composition (MOX) and increasing the design life time beyond 40 years.

Article 12 of the Ministerial Nuclear Safety Regulation for Nuclear Installations empowers the ANVS to compel the LH to cooperate in a process of total revision and updating of the licence. This will be necessary if, for instance, the licence has become outdated in the light of numerous technical advances or if new possibilities to even better protect the population have become available since the licence was issued. These new advances or possibilities would come to light in a 10-yearly review, as described in the ANVS Guideline 10-yearly review for nuclear installations, or any other periodic safety review.[48]

In line with its policy on transparency, the ANVS has published a document on its website[49] that describes its licensing policy. With a view to the plans for new nuclear power, the ANVS has published a document on licensing new nuclear power plants and the role of the ANVS in it. It also has published a document on its supervision and enforcement policy. There are more guidance documents, that aid LHs and applicants in submitting licence applications. This all helps to improve the interaction between the ANVS and the LHs, and make it more efficient.

Figure 3 Licensing procedure under the Nuclear Energy Act

- Informal discussions applicant and the ANVS about application and EIA.
- The EIA is prepared by the applicant and must be submitted to the ANVS at the same time as the licence application. Although not required by law, the ANVS advises the applicant to submit a scope and content advisory report, a document that indicates what the EIA must comply with.
- Applicant drafts its EIA and other documentation that will accompany the licence application. There is no regulatory limit to the time it takes to prepare the required documents.
- Applicant submits EIA report together with the application and other required documentation to the ANVS.
- The ANVS determines if application satisfies procedural requirements and expected completeness. The ANVS notifies the applicant whether the application is admissible, or needs more work.
- Once the application is considered to be complete, the ANVS notifies the general public. For six weeks, the ANVS offers the public the opportunity to read printed versions of the documents at the ANVS offices and at the town hall of the municipality in which the nuclear installation is (to be) located. In this phase it is not possible to submit opinions to the ANVS.

[48] Dutch: Handreiking tienjaarlijkse evaluatie nucleaire installaties

[49] This is the document 'Vergunningenbeleid ANVS' (Dutch), refer to https://www.autoriteitnvs.nl/binaries/anvs/documenten/publicatie/2017/08/01/vergunningenbeleid-anvs/WEB_118940_Vergunningenbeleid.pdf

- The ANVS starts evaluating and assessing the application and its documentation, to arrive at a draft decision. It will also judge if it is possible to do this in six months. With more complicated applications, the ANVS may extend this period, although opinion of the applicant about this extension will be taken notice of.
- When the draft decision is completed the ANVS will send its draft decision to the applicant and other authorities involved. The ANVS can also decide to send it to the Cmer to ask its advice on the decision. Furthermore, the decision is made public and anyone may submit opinions within the following six weeks.
- If the ANVS asked the Cmer to give advice, it will receive advice on the draft decision. Cmer may also give advice on opinions submitted to the ANVS, if the ANVS requested it.
- The ANVS formulates final decision, if applicable taking notice of advice of Cmer and opinions submitted and describing how this input has been used. The ANVS sends the decision to applicant, if applicable Cmer, and anyone who has sent an opinion on the final decision.
- The final decision is made public like described before. During six weeks, stakeholders and anyone else are free to lodge an appeal with the Administrative Jurisdiction Division of the Council of State (the highest administrative court in the Netherlands) against the decision by which the licence is eventually granted, amended or withdrawn. The Council of State will issue a decision within one year.

Some of the ANVS' guiding principles regarding licensing, as well as supervision and enforcement, documented in above-mentioned documents, 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 are an essential element of safety.
- Responsibility of the LH and justifiable trust. The LH is responsible for (nuclear) safety. The ANVS supervises the LHs and assesses if the trust vested in the LHs is justifiable.
- Emphasis on continuous improvement. The safety must remain 'state-of-the-art' as far as reasonably achievable. A changing environment, technological advances, lessons learnt from incidents and accidents and so on all may give rise to implementation improvements, also taking account that the LHs need 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.

The ANVS guidelines are informative documents that the ANVS publishes for the benefit of licence holders and which describe how the ANVS views a specific subject. The licence holder can then use the guidelines as a starting point when drawing up his documents and in his actions. Guidelines are not linked to a licence or the law, and are not binding for the user. It must be taken into account that, based on the general principles of good governance, such as the principle of due care, the ANVS follows this guideline and can only deviate from it if the level of safety is guaranteed to be equivalent.

Principal responsible authority

The authority most relevant with respect to the regulatory process under the Nuclear Energy Act is the ANVS. In addition to the Nuclear Energy Act, several types of regulation may apply to a nuclear facility and the activities conducted in it and/or supporting it. Therefore often there are several authorities, sometimes at several levels in the governmental organisation involved in the licensing procedures.

The civil engineering part of the construction of a nuclear installation and local spatial planning aspects will be licenced under the Environment and Planning Act by local authorities on the level of towns or

rural municipalities. Fire safety is relevant to nuclear safety and therefore relevant for assessment by the ANVS, but it is also one of the topics relevant when assessing an application for a building licence and, thus, it is in principle also within the scope of the local authorities. For the use of water from aquifers and the discharge of water into surface waters, a licence under the Environment and Planning Act is needed. Provincial and other local authorities may then be involved.

Coordination regulation

For projects related to large scale energy infrastructure, special government coordination regulation applies, that is subordinate to the Environment and Planning Act. Large scale projects that may be subject to government coordination regulation are for instance the construction of power plants with an electrical power greater than 500 MWe, investment in the power grid, et cetera. The coordination regulation supposes involvement of the Ministry of Climate Policy and Green Growth (KGG). With such large projects, the Ministry is assumed to be the coordinator, organising the interaction between the many authorities, each of which will perform its own legal duties.

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 8 in the present report, section 8.1(a).

With a licence application, it very often is compulsory to conduct an Environmental Impact Assessment or EIA. It is compulsory for all reactors with a thermal power higher than 1 kW. The Netherlands has a permanent commission, the Commission for the Environmental that can advise the government and the RB on the requirements of all EIAs conducted in the Netherlands, including those related to nuclear facilities.

Notified bodies

Notified Bodies can qualify as nuclear pressure equipment inspectorate, if they can demonstrate additional qualifications in design, fabrication and inspection of nuclear pressure equipment. After positive evaluation of the Notified Body by the ANVS, it can be accepted by the ANVS. Under this system, the LH can select an accepted Notified Body, to inspect his nuclear pressure equipment. Refer to section 7.2(c) for more information on Notified Bodies.

7.2(c) System of 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 the text on Article 8 of the Convention for more information on the ANVS.

The Bkse states that it is not allowed to use in a nuclear installation nuclear pressure equipment that is not approved by a designate body. To become a designated body a company has to comply as a basis to the same requirements as a designated body under the conventional European Pressure Equipment Directive would have to comply with, as well as a few additional nuclear-specific requirements as described in the ANVS Regulation on Nuclear Pressure Equipment, Security and Decommissioning. The ANVS is tasked with designating companies under this regulation. Licence Holders are free in deciding which designated body to use for the necessary approval in design, fabrication and inspection of their

nuclear pressure equipment. The ANVS determines the requirements and conditions for the work done by a designated body.

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 Report (SR) 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), et cetera.

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 do not require a licence modification.

During the licensing phase the ANVS assesses among others, whether the applicable NVRs (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 and accidents in the various plant categories. The ANVS lays down the guidelines for the required calculations regarding radiological consequences (data for food consumption, dispersion, et cetera).

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 may choose to use support from a foreign or national TSO in these activities.

In the final stage of the licensing procedure, the inspectors of the ANVS are asked to verify the draft licence including its licence conditions and requirements regarding its appropriateness for enforcement. This includes an assessment of the draft licence to establish if compliance with the proposed licence conditions can be enforced and duly verified, and if the set of conditions is susceptible to fraud.

Review and assessment during operation

The licences of nuclear installations contain conditions requiring the LH to perform PSRs, and stating their periodicity. Identified safety improvements are to be implemented as far as reasonable.

Regulatory inspections

The function of regulatory inspections mainly is:

- To check that the LH is acting in compliance with the regulations and conditions set out in the law, the licence, the safety analysis report, the Technical Specifications and any self-imposed requirements;
- To investigate/assess any (reported) violation of these regulations and conditions and if necessary to initiate enforcement action;
- To check that the LH is conducting its activities in accordance with its Safety Management system;
- To check that the LH is conducting its activities in accordance with the best technical means and/or accepted industry standards;
- To check that the LH is committed to continuously improve nuclear safety.

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

The LH must act in compliance with the Nuclear Energy Act, the licence and the associated Safety Analysis Report (SAR). The compliance is verified with a system of inspections, audits, assessment of operational monthly and/or quarterly (depending on the licencee), reports, and evaluation of operational occurrences and incidents. Inspection activities are supplemented by international missions.

An important piece of information for inspection are the two-yearly (or five-yearly, depending on the licencee) safety evaluation reports, in which the LH presents its own self-assessment of performance with respect to the licence base on technical, organisational, personnel and administrative provisions. These self-evaluations, which are mandatory under the licence requirements, and the missions contribute to the continuous improvement of safety at the nuclear installations.

The management of inspections is supported by a yearly planning, the reporting of the inspections and the follow-up actions. A number of times per year, all the ANVS inspectors and experts together review the situation of the licencees in each area of supervision[50], which yields future inspection priorities. A number of times per year there are meetings of the management of the LH and the ANVS. The discussions are mainly about general issues relating to supervision activities. More often technical or project meetings between LH staff and the ANVS staff are held, discussing issues or progress in relation with inspection findings or assessment activities. There are also regular inspections of the LH's incident analysis group activities.

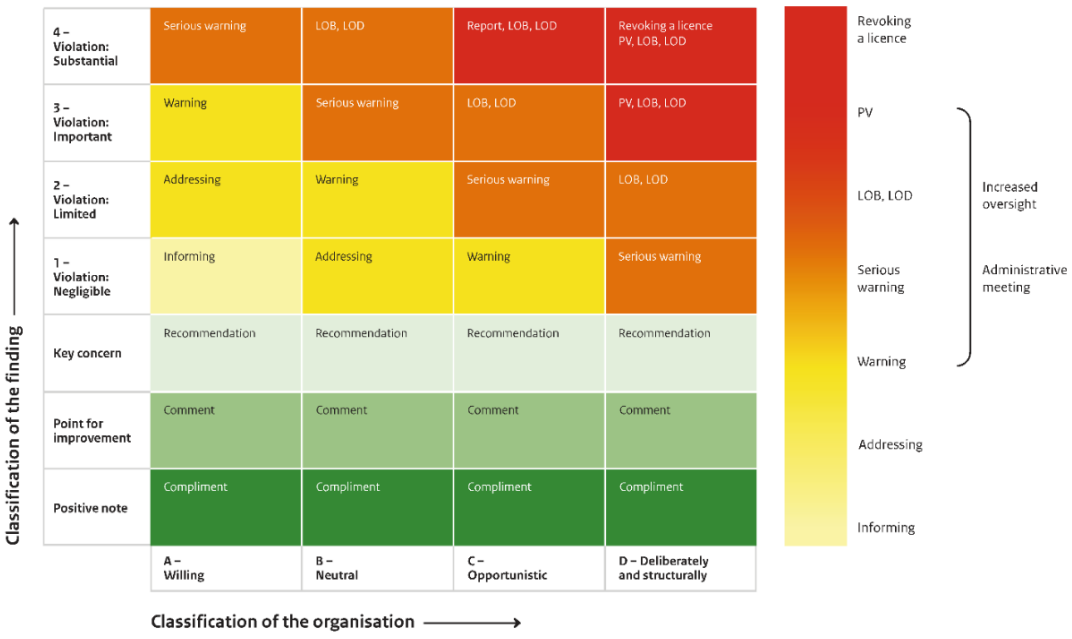
Inspections are generally characterised by an emphasis on technical judgement and expertise. They are compliance-based, meaning that the ANVS investigates whether the LH is acting in accordance with the terms of the licence. Other compliance-based inspections focus on organisational aspects. However part of the inspections on the organisation are more goal-oriented and are focussed on the behavioural aspects of the organisation and the individuals within. There is a need to scrutinise the way the LH has fulfilled its responsibility for safety and to ascertain whether the LH's attitude shows a sufficient awareness of safety aspects (i.e. safety culture). Supervision on these aspects of human and organisational factors often needs a different approach than supervision on technical issues. For example the ANVS has practiced annual meetings at the management level about these subjects with a number of LHs, where it was felt to be beneficial and proportional.

7.2(d) Enforcement of applicable regulation and terms of licences

Enforcement

In line with its policy on transparency, the ANVS published a public document on its supervision and enforcement policy in 2017. It shows that enforcement actions are proportionate.

Figure 4 Intervention matrix used in decision making on interventions.



[50] The teams doing these reviews are referred to as 'helicopter teams'

As an aid in decision making, the ANVS uses an 'intervention matrix'. When considering observed deviations from regulatory requirements and licence conditions, the matrix can be used in deciding what follow-up will be needed. In the decision making both the potential for more or less serious impact on safety is considered, but also the track-record of the LH in meeting his regulatory obligations and his attitude to meeting such obligations.

In the matrix, classes of LHs range from (A) 'willing', via (B) 'neutral' and (C) 'opportunistic' to (D) 'deliberately & structurally'. Interventions range from 'comment' on a 'point for improvement' to 'revoking a licence' for a 'substantial violation'. The matrix also leaves rooms for compliments related to positive notes. The intervention matrix was redesigned in 2023, as part of a wider update of the Supervision and Enforcement Strategy. The strategy now also includes the ambition to have a multi-year supervision and enforcement planning. With such a planning blind spots can be prevented effectively. Furthermore, risk-based oversight can also be anchored more firmly.

In the inspection report sent to the LH, the ANVS will make clear what deviations are found and depending on the severity what kind of intervention the ANVS will make and which actions (including their timing) are required from the LH. These are formulated SMART[51].

Measures can be taken to enforce the conditions of the licence conditions. Article 83c of the Nuclear Energy Act grants the power to the authority to impose an administrative enforcement order subject to a penalty.

Article 83a of the Nuclear Energy Act with reference to the Environment and Planning Act empowers the authority to revoke a licence (Environment and Planning Act Article 18).

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.

Should there be any 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 such measures as deemed necessary, including (temporary) shutting down the nuclear installation. This article, however, has never been enacted to date.

The overall effectiveness of the enforcement actions under the new policy will be evaluated once there is a sufficient number of cases. In general the number of cases is low.

Examples of individual enforcement actions in the past years are:

- In 2022 EPZ was issued with a warning because they were using x-ray diffraction analysers without a licence. These analyser could be used without a licence up until 2018 when the European Basic Safety Standards for working with ionising radiation where implemented in Dutch law. EPZ had overlooked the change in the legal requirements and applied for a licence in 2022, but because they were late in doing so were issued a formal warning.
- In 2023 EPZ was issued with a warning because the operator failed to fully implement an alarm system for environmental dose rate monitoring system. The operator had proposed to install such an alarm system in the periodic safety review as part of the modernisation of the dose rate monitoring system. Because the operator had been granted ample time and several extensions but upon inspection could not demonstrate full functionality according to the proposed change, the authority decided to issue them with a warning under penalty of a fine.
- In 2023 the HFR organisation received official warnings with regard to their process for Operational Experience Feedback (OEF) and failure to report specific events that require reporting in

[51] SMART: Specific: make clear what needs to be done. Measurable: it should be possible to demonstrate the action has been completed, when it has been completed. Acceptable: it should be reasonable to require the action(s). Realistic: it should be achievable. Time bound: there is a deadline for completion of the action(s)

accordance with Dutch regulation. In 2024 they also received a warning with regard to the (insufficient) investigation of such events.

7.3 Summary of Significant Changes Since Previous Report

- On the 1st of January 2023, a new assessment framework for acceptance of alternative packages of reprocessed fuel came into force.
- The ANVS-Regulation on Basic Safety Standards for Radiation Protection was amended on July 1 2023 in connection with the determination of the maximum period within which radioactive waste and fissile materials or ores containing waste must be removed.
- On the 1st January 2024, the new Environment and Planning Act came into force.
- As of January 1st 2025 the Nuclear Facilities, Fissionable Materials and Ores Decree also regulates the main security principles for nuclear installations and fissile materials.
- This Ministerial Decree with regard to Nuclear Pressure Equipment Regulation, Security and Decommissioning, as amended on January 1 2025, now includes provisions for other pressure equipment.
- The ANVS Regulation regarding the Ministerial Decree mentioned above entered into force on January 1 2025.
- Update of the Supervision and Enforcement Strategy in 2023, including a redesign of the intervention matrix.

7.4 Notable achievements

- Update of the Supervision and Enforcement Strategy in 2023, including a redesign of the intervention matrix.

7.5 Future Focus

- Keeping the national regulatory framework up-to-date for new and future developments.

Article 8. Regulatory body

8.1 Each Contracting Party shall establish or designate a Regulatory Body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

8.2 Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the Regulatory Body and those of any other body or organisation concerned with the promotion or utilisation of nuclear energy.

The Kingdom of the Netherlands fulfills the obligations of Article 8.

8.1 Regulatory Body

8.1(a) Regulatory Body – general

The RB is the authority designated by the Government as having legal authority for conducting regulatory tasks, including issuing licences, and thereby regulating nuclear, radiation, radioactive waste and transport safety, nuclear security and safeguards. These tasks related to nuclear safety are within the scope of the ANVS only. Therefore this report often refers to the ANVS as the RB.

Evaluating and preparing policies, acts and regulations is not part of the tasks of the ANVS, that is the responsibility of the Ministry of I&W. Refer to section 8.1(d) for more information.

Establishment of the RB

In 2015 entities that formerly constituted the RB for nuclear safety and radiation protection, merged into one entity, the Authority for Nuclear Safety and Radiation Protection, Dutch acronym ANVS. May 1st 2015 saw the transfer of political responsibility from the then Minister of Economic Affairs[52] to the Minister of Infrastructure and Water Management. From May 1st 2015 until August 1st 2017, the ANVS operated under mandate of this Minister.

The ANVS attained its formal status of an independent administrative body (Dutch acronym zbo) on August 1st 2017 with the necessary amendment of the Nuclear Energy Act and subordinate regulation.

Legal status

The tasks and mandates of the ANVS are described in the Nuclear Energy Act, in its chapter II. Also refer to the text on Article 7.

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. It is the entity designated by the government as having legal authority for conducting the regulatory processes, including issuing authorisations, supervision and enforcement. This type of independent administration explicitly meets the international requirements (EU-safety directive, CNS and IAEA standards). It is legally laid down in law that ANVS staff shall carry out its duties independently.

The Minister of Infrastructure and Water Management bears ministerial responsibility for the ANVS.

Advisory Board

[52] Nowadays the Minister of Climate Policy and Green Growth

The ANVS appointed an Advisory Board 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.

8.1(b) Other governmental entities with responsibilities

There are some interfaces with other governmental entities. Refer to the text on Article 7 of the Convention for more information on those entities and their tasks.

8.1(c) Regulatory Body –tasks

Currently by law the ANVS has the following tasks:

- Granting licences; all nuclear facilities in the Netherlands, including the NPP of Borssele, 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. This includes supervision of the radiological safety of workers at the nuclear installations.
- Providing advice on policy and legislation based on its specific knowledge and expertise, in conjunction with its other tasks assigned by or pursuant to the law. 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.

8.1(d) Organisation of the ANVS

Recent changes

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 evaluation was conducted under the auspices of the Ministry of I&W.

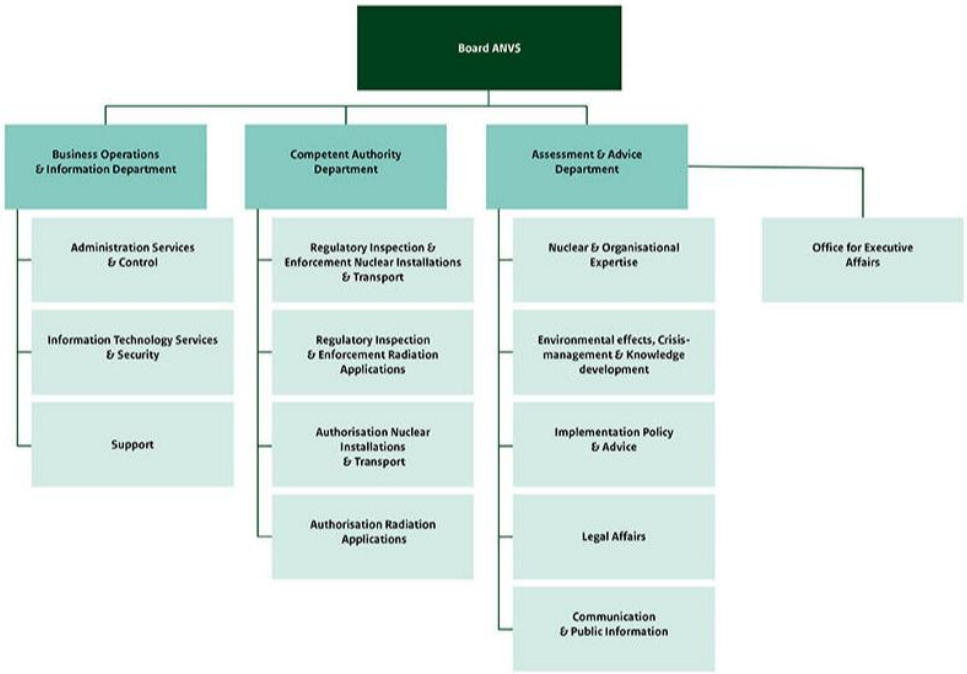
The two evaluations eventually resulted in two major decisions:

- Reorganisation of the ANVS. This reorganisation was completed by January 1st, 2020.
- Transferring the responsibility for the task ‘Evaluating and preparing policies, acts and regulations’ to the Ministry of I&W. The change came into effect on May 15th 2020 and was formalised in 2024 by a change of the Nuclear Energy Act. The task advising on policy and legislation and regulations on the basis of its specific knowledge and expertise remains with the ANVS. The ANVS also keeps the task of participating in the definition of regulations on nuclear safety as referred to in Article 5(3)(a) of Directive 2009/71/EURATOM of 25 June 2009 establishing a Community framework for nuclear safety for nuclear installations (PbEU 2009, L 172), as last amended by Directive 2014/87/EURATOM of 8 July 2014 (OJ 2014, L 219).

In early 2023 the internal structure of the ANVS was altered; it was decided to create three departments: Assessment & Advice, Business Operations & Information, and Competent Authority. These departments are responsible for undertaking the legal tasks of the ANVS and each have their own distinctive expertise.

On the next page, the organisation chart of the ANVS is presented.

Figure 5 Organisation chart of the ANVS



The recent internal organisational change aimed to achieve the following goals:

- Preparing the organisation to allow for further developments (expansions or other changes).
- Making business operations more robust and positioning them more firmly.
- A clear division of roles and responsibilities between all layers of the ANVS.
- Further stimulate and facilitate ownership, independence and responsibility (professional autonomy) among employees.
- Strengthening the function of the team leaders of the substantive teams by adjusting the resources, powers and responsibilities so that they can better manage the tasks and objectives of a substantive team.
- A compact and strategically operating management team (DT).
- Better interaction between organisation and board to be able to operate more strategically.
- Achieve better horizontal and vertical connection, both internally and externally (facilitate good discussion between partners at a comparable level).

Details of current organisation

The ANVS is led by two Board Members. In implementing its tasks, the ANVS can rely on support from various organisations, listed below in section 8.1.(k) 'External Technical Support'.

- The Board Members are not civil servants but have been officially appointed as independent Board Members whom are in charge of the ANVS.
- The staff of the ANVS are employed by the Ministry of I&W as civil servants but work for the Board.

8.1(e) ANVS licensing, supervision and enforcement policies

These policies have been described in sections '7.2(b) System of licensing',' 7.2(c) System of regulatory assessment and inspections' and 7.2(d) Enforcement of applicable regulation and terms of licences'.

The ANVS has documented these policies. 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 8.1(j)). In this way LHs 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 8.1(i) on quality management).

In the Netherlands, licensing in the field of nuclear safety is conducted by the ANVS. Licencees must meet requirements of the Nuclear Energy Act and other relevant regulation.

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 and various Inspectorates, to the extent that this is within their authority. The ANVS also cooperates with the Dutch Customs.

8.1(f) Coordination of activities for managing nuclear accidents and incidents

Refer to the text on Article 16 on emergency preparedness and response for the relevant details.

8.1(g) Development and maintenance of Human Resources and competence

Current manpower situation

The ANVS operates a regular planning and control cycle. In this cycle, the tasks to be undertaken are planned, taking into account the staffing levels available, while priorities are set when and wherever necessary.

The current level[53] of staffing is 176.8 FTE, including two Board members. In line with the new nuclear ambitions described before, the staffing of the ANVS is expected to grow to approximately 250 FTE by the year 2030. The ANVS has a multi-year capacity building plan – broken down into function groups – to facilitate this growth. In the development of this plan experiences from the (pre-)licensing of the PALLAS reactor have also been taken into account. The capacity building plan has been shared with Belgian regulator FANC and Swedish regulator SSM. At the review meeting, an update of the staffing at that time will be provided.

The ANVS has also developed a traineeship programme for recent graduates, which starts in September 2025. The programme focuses on broad development: trainees will rotate through four departments over two years, guided by trained mentors, with a strong emphasis on both technical and professional skill-building. If successful, the trainees may be offered permanent roles. The programme is not only attracting new talent but is also enhancing internal training structures.

The ANVS is committed to the ambitious growth targets described above. Simultaneously, it maintains a careful balance with its current tasks and responsibilities to ensure that core processes such as supervision and licensing are carried out as before. This balanced approach is reinforced by a strategic focus on enhancing the organisation's absorptive capacity, ensuring that ANVS is well-equipped to assimilate new knowledge and innovations effectively as it scales.

Qualification, experience and expertise (disciplines and training)

The ANVS has developed and is further developing a multi-annual HR-plan that also is the basis for recruitment and the management of qualified staff. The regular updates of the plan serve as input for the draft budgets the ANVS makes and submits to the Minister of I&W.

The expertise of the ANVS spans disciplines in areas like radiation protection and nuclear safety – with all kinds of expertise like mechanical engineering, electrical engineering, PSA, deterministic safety analysis, fire safety, human and organisational factors, waste safety, transport safety, conventional safety, risk assessment, security and safeguards, emergency preparedness and response, legal and licensing aspects and relevant financial topics. Other disciplines that needed further development were knowledge

[53] Reference date 31th of December 2024

management and public communication. Therefore, ANVS has contracted staff with the necessary expertise in these areas. When needed, knowledgeable advisors are contracted for support.

The ANVS provides specialised training for its staff and has a dedicated education plan for each function group. Education plans and the relevant trainings are combined into a single platform: the ANVS Academy. This learning & development platform offers training in technical aspects as well as personal development. This platform was launched in June 2022 and will continue to mature.

Part of the training policy is that 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. These are offered to the staff via the ANVS Academy. This includes international workshops, but also conferences and visits to other regulatory bodies. In addition, there is information exchange through the international networks of OECD/NEA, IAEA, EU 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 as team member, such as e.g. IRRS, ARTEMIS, IPPAS, EPREV, or INSARR.

All ANVS staff maintain training plans that are discussed annually with their team leader. In addition to formal education courses, the ANVS utilises informal, voluntary learning opportunities, including presentations, workshops and online training courses.

Staff requiring specific expertise, such as inspectors, receive the specific training required and participate in a mentoring programme 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.

The ANVS participates in a number of research activities and knowledge databases under the auspices of OECD-NEA such as FIRE, CODAP, ICDE and HEAF. The ANVS also participates in the IAEA IGALL programme. Furthermore the ANVS supports internships within the ANVS of Bachelor and Master students of various fields. Next to this, supported by the ANVS, the Dutch Institute for Public Health and the Environment (RIVM) participates in scientific research projects, such as MELODI on low dose health effects. NRG-PALLAS is actively participating in HORIZON research projects on nuclear development and material science, co-financed by the ministry of Climate and Green Growth.

Challenge 2023-01: “ANVS managing the (need for) fast growing human resources

- Recruitment efforts in a tense labour market in competition with industry
- Dealing with the fast growing number of new workers (training/tutoring)
- Prevention of existing and new workers leaving (worker satisfaction)”

To date, the ANVS has been able to manage the workload. Although the ANVS is successful in fulfilling its vacancies, there remain challenges in finding enough adequately qualified staff. Therefore the ANVS has a multi-year capacity building plan, broken down into function groups, in place that facilitates future growth. Furthermore, the ANVS has developed a traineeship programme for recent graduates, that starts in September 2025.

Next to this, the ANVS Academy also aids in a structured approach of training and tutoring of new workers, as well as offering personal development options for existing workers.

Experience Feedback (OEF and REF)

The activities to learn from Regulatory and Operating Experience and Knowledge Management are being restructured and reinforced by the ANVS and the newly established structure of the organisation should

aid this effort. The ANVS participates in the common international projects on databases as ISR, IRSRR[54], FINAS[55] and others.

The participation in inspection teams of neighbouring countries, the participation in international IAEA missions in various countries and the participation in the ENSREG-led TPR Fire Safety in 2024 also is an example of OEF- and REF-related activities of the ANVS. These all are continuous efforts.

In recent years, cooperation agreements with several foreign RBs were signed. Examples of such agreements include agreements with NNR (South Africa, 2023), ASN[56] (France, 2023), ONR (UK, 2024), NSSC (ROK, 2024), Polish counterpart PAA (Poland, 2024). Also the MoUs with RBs FANC of Belgium and ARPANSA of Australia were renewed in 2024. Furthermore, in July 2024, the ANVS hosted the annual KWUREG meeting in The Hague. During this meeting information such as operational experience was exchanged on KWU reactors.

Also, the Netherlands received IRRS, ARTEMIS and IPPAS missions in 2023.

Contracted support

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. Major examples where the ANVS uses TSO-support are the PSR of the NPP, and the new research reactor project PALLAS.

More about contracted support can be found in section 8.1(k) 'External Technical Support'.

8.1(h) Financial resources

Budget allocation process

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 I&W will allocate sufficient financial resources for the ANVS to carry out its duties.

The ANVS makes a draft budget for its financial needs for the following year. It sends this draft budget to the Minister of I&W by 1 April each year (article 25 IAAFA[57]). The ANVS thereby participates in the ministerial budgetary process which is derived from the State budgetary process. The budgetary process is described in "Begrotingscyclus en concernsturingscyclus bij IenM". Note: IenM is the Dutch abbreviation of Infrastructure and Environment, the former name of the current Ministry of I&W.

The Minister of I&W decides upon the draft budget of the ANVS. He is hereby legally obliged to make sufficient funding available to the Authority for the exercise of its duties (article 9(1) Nuclear Energy Act). The Minister includes the ANVS as a separate budget item in his budget and provide notes on this item in the Explanatory Memorandum (article 9(2) of the Act).

The budget of the Ministry of I&W has the form of a Bill. The approval of it follows the regular procedure for the approval of a Bill: approval by the Council of Ministers, advice of the State Council, approval by both Chambers of the Parliament, signing by the King and the Minister, and publication in the Official Journal.

Current budget

[54] IRS: Incident Reporting Systems for Nuclear Installations, IRSRR: Incident Reporting System for Research Reactors

[55] FINAS: Fuel cycle Incident Notification and Analysis System

[56] In 2023 this was ASN, after merge with IRSN it is now ASNR

[57] Independent Administrative Authority Framework Act, IAAFA; Dutch: 'Kaderwet zelfstandige bestuursorganen'

Already in 2015, even before having the formal independent status of a zbo, the ANVS had a dedicated budget that it could spend on its own behalf. The starting point of its budget then (€ 27 million) was the sum of the budgets of the merged entities. Due to budgetary claims, the total annual budget in 2024 rose to € 37.5 million. The budget of the ANVS for contracted support in 2024 was about € 13.4 million out of € 37.5 million, mostly spent on contracted support provided by organisations like RIVM[58], on a TSO-consortium led by Bel-V and in smaller contracts with organisations like GRS, NRG and Applus-RTD and SCK-CEN.

The resources at the ANVS currently are adequate, in terms of financing.

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

In 2021 and 2022 a complete review of the ANVS management system against Dutch law (article 16 of the Nuclear Safety and Nuclear Installations Regulation) and the IAEA Standards was carried out. In 2022 a plan was drafted for a programme to further improve the current management system. This AIM programme started at the end of 2023, and it will run for four years. The goal of the programme is to further implement "continuous improvement" in the day-to-day work of ANVS staff, to implement improvements of the ANVS processes and procedures on a more frequent basis and to improve the application which is used for the management system (to make it more user friendly).

In the IRRS mission of 2023 to the Netherlands the review team also took note of the AIM programme and recommended that the ANVS further develop it and ensure that the system is used throughout the organisation. Furthermore, the team also recommended that the ANVS include certain elements in the AIM system such as:

- The pre-licensing steps of new facilities;
- Processes for updates of existing licences;
- Internal guidance procedures and processes for review and assessment of radiation source facilities and activities;
- Processes for the regulatory integrated safety assessment activities.

8.1(j) Openness and transparency of regulatory activities

Legal requirements on openness and transparency

Legal requirements on transparency by the ANVS comes from several international sources like the EU-Directives on Nuclear Safety, on Radiation Protection, and on Management of Radioactive Waste and Spent Fuel. Such requirements have been transposed in the national regulations like MR NV and Bbs. But also other international conventions define such requirements. A working paper[59] published by ENSREG in 2009 and updated in 2016 provides an overview of such obligations and has been taken notice of by the ANVS. In addition, the ANVS contributed to a more recent ENSREG publication[60], which is a guide on openness and transparency for European nuclear safety regulators, with guidance extending beyond the legal obligations set out in Article 8 of the Nuclear Safety Directive, Article 10 of the Waste Directive and the relevant articles of the Basic Safety Standards Directive. The ANVS has fully implemented this ENSREG guide.

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 Environment and Planning Act. This process also involves meetings of

[58] 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'

[59] "Current Community and International Law with Relevance to Transparency", ENSREG working document HLG_r(2015-31)_319, 2016

[60] "Guidance on Openness and Transparency for European Nuclear Safety Regulators", ENSREG working document HLG-p(2019-39)_165

Regulatory Body, LH and the public. The ANVS is transparent in its communication of regulatory decisions to the public (e.g. on licence applications and adequacy of 'stress tests'); these are published with supporting documentation.

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.

Dedicated team of communication staff, online presence

The ANVS has a dedicated team of communication staff, which is currently a group of 7 FTE. This is a positive development and aids the ANVS in meeting its objectives for openness and transparency.

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. The communication tools are continuously improved. Relations with national, regional and local stakeholders and press are gradually built. In 2022 and 2025 the ANVS organised relationship events for its stakeholders; the ANVS also had meetings with stakeholders. The ANVS uses its website, LinkedIn and YouTube to communicate with stakeholders, media and the general public. In recent years, the ANVS has also investigated how professionals and citizens, among others, perceive the information on the website. Discussions have also been organised for this purpose. The results from these studies are used to improve the online information provision via the website.

Information activities

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 CNS, National Reports of Action plans related to the stress test, et cetera. In general at least twice a year, the Minister sends a letter to the Parliament with a general update on all important issues with respect to nuclear safety and radiation protection. Furthermore the ANVS reports about its activities in its annual report.

Since 2020, all ANVS enforcement decisions that have become irrevocable are published on the ANVS website.

Currently, a significant amount of regulatory information and products are published on a regular basis, mostly on the ANVS website. Examples are:

- ANVS licences;
- ANVS enforcement decisions;
- Information on national policies and regulatory framework in the Netherlands;
- ANVS regulations;
- General information about ANVS' tasks and activities;
- ANVS Annual Report and Annual Plan;
- 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;
- Continuous news updates in English and Dutch on website;
- National reports, published in relation to international conventions and legal instruments related to nuclear safety, are made public by publishing them on governmental websites;
- Results of international peer reviews of aspects of the operation of nuclear installations, like IAEA mission report;
- A notable document is the "National Policy on Nuclear Safety and Radiation Protection (Guide for Readers)", containing an overview of actual Government policies on nuclear safety and radiation protection, which has been prepared by the ANVS in cooperation with relevant Ministries. Parliament was informed about the document and it was published on the Internet[61].

Further initiatives

The ANVS has made a start with periodically publishing reports on the State of Nuclear Safety and Radiation Protection. After the first publication in 2020, that focused on the nuclear safety and radiation protection in Dutch nuclear installations, a second edition was published in 2022. The focus of this report was on the radiation protection concerning radiation applications in the medical and industrial sectors, as well as sectors concerning natural radioactivity such as geothermal energy and oil and gas extraction. Also activities concerning the protection against unplanned exposure situations and orphan sources, by for instance customs and the scrap metal sector, were evaluated in this report. Concerning the nuclear sector, the ANVS issues a report on unplanned events and incidents in nuclear installations on a yearly basis.

On 1 May 2022, the Open Government Act came into force. The new act requires a much more proactive attitude than the previous law. The active disclosure of documents is a major operation and has been introduced step by step.

In the field of public access, the ANVS took the first steps in 2024 to offer public information in a central location on the Publication Platform Implementation Content (PUC). This platform will later also be made accessible via the government-wide publication platform that is under development. The ANVS annual plans and annual report can be found at this new location. The other categories of information will follow in 2025. For example, decisions such as registration decisions of the source type and approval decisions of decommissioning plans. In this way, we comply with the legal obligation under the Open Government Act to actively disclose information. The ANVS is connected to the Open Government Act index with which citizens can find the information from the ANVS.

In the field of social media, the ANVS has stopped using platform X, whereby all information published on that platform (including reactions) has been secured in the DMS.

In addition to good systems and processes, the human factor is crucial in transparency. In 2024, the ANVS also invested in this, by offering a specialised training in the induction programme of new employees. For current employees, we have developed training courses on the usefulness and necessity. Furthermore we have emphasized the topics of accessibility and disclosure through an awareness campaign.

8.1(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) for providing technical support.

Support for nuclear safety and security

The main TSO for providing support is a consortium of Bel V, ASNR (IRSN until 2024) and Bureau Veritas from Belgium and France. The contract was signed in 2021 for a maximum of 10 years. The areas that

[61] Link: https://english.autoriteitnvs.nl/documents/publication/2018/11/1/guide-for-readers

they provide support in are inspection and assessment, expertise on demand, research, project and programme management, and workshops and training. The consortium is used for providing support for all existing and new nuclear installations.

Next to this, services from other TSOs are used. NRG-PALLAS in Petten and Arnhem provides consultancy & educational services to government and industry. 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-PALLAS is the operator of the HFR research reactor and the upcoming PALLAS reactor. As they are a licencee of the ANVS, the contracts have strong requirements for preventing any conflict of interest.

GRS provides services focussed on review and assessment for security, and maintaining and developing a software-bases analysis simulator for the Borssele NPP.

Support for crisis management and radiation protection

The main knowledge partner of the ANVS in the expertise fields of radiation protection and crisis management is the National Institute for Public Health and the Environment (RIVM). RIVM is an agency[62] of the Netherlands Ministry of Health, Welfare and Sport (VWS). RIVM's remit is to modernise, gather, generate and integrate knowledge and make it usable 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. RIVM is mainly commissioned by governmental organisations like ministries and governmental inspectorates. It also performs studies for the EU and the UN. The ANVS annually commissions work to the RIVM in research and support programmes to strengthen the knowledge base of the ANVS, for environmental monitoring, to support oversight and inspection activities.

Furthermore, 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 and is a partner in the Crisis Expert Team radiation and nuclear (CETsn) for radiological and public health advise in nuclear and radiological crisis situations. RIVM also operates the national radiological monitoring network and a radionuclide laboratory for environmental monitoring and research.

The 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.

The ANVS has a combined mini-tender framework contract with Belgium research institute SCK CEN and NRG-PALLAS for consultancy in the area radiation protection. SCK CEN operates two research reactors at its site in Mol, Belgium.

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, safety and security to clients from nuclear and non-nuclear businesses and various governmental organisations, as well as students. In a cooperation of these two organisations and the nuclear sector as a whole, recently the Nuclear Academy was established to further expand and enhance nuclear education and training.

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 with several levels of expertise is defined in national legislation. Institutes providing these courses are recognised by the government. Radiation protection experts acting as such at a licencee need to be registered, based on requirements for continuing education and work experience.

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[62] Dutch: 'agentschap'. The Ministry of VWS is the owner of RIVM

8.1(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 8.1.(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.

8.2 Status of the Regulatory Body

8.2(a) In governmental structure

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 I&W bears ministerial responsibility for the functioning of the ANVS. However as a zbo, hierarchically the ANVS is not subordinate to the Minister.

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 of 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;
- Annul decisions of the ANVS if they are in violation with the law;
- Taking the necessary measures if the ANVS is seriously neglecting its tasks.

8.2(b) Future development of the RB

Case management

When the ANVS was established in 2015, the primary processes for licensing, supervision, and enforcement were supported by three different IT systems. In 2016, the ANVS implemented its own case management system to support the process for notifications and registrations.

The system was subsequently expanded gradually. Between 2019 and 2021, the ANVS integrated the processes for licensing, supervision, and enforcement into the case management system. In the years that followed, the ANVS gained extensive experience with this system and developed a target architecture for the digital transformation towards data-driven operations. Establishing an ANVS data model and implementing a data platform are part of this transformation. The financial and technical lifespan of the current case management system ends in 2026, necessitating its replacement.

In 2024, the ANVS launched a separate programme consisting of three interconnected projects aimed at realising the target architecture (project BOSON). That same year, the ANVS prepared for the procurement of a platform to replace the current case management system in 2026 and for the development of the ANVS data model. In 2025, preparations will begin for procuring a data team and implementing a data platform.

Several recommendations from the IRRS 2023 mission to the Netherlands are related to project BOSON, namely the registering of highly active sealed sources, establishment of effective mechanisms to coordinate inspection planning, and a structured monitoring of implementation of corrective actions. These will be integrated into dashboards in the target architecture.

Challenge 2023-03: Attacks on automation systems: The threat of (digital) attacks on automation systems is growing rapidly, both nationally and internationally. The associated risks may increase as more operational technology systems are digitally and remotely controlled. In the nuclear domain, both criminal and state actors are considered as a threat. It is important to be remain alert in order to minimise such risks in the nuclear sectors. The ANVS cooperates with LHs and various national security services in this field."

In 2023 the state issued an updated 'Design Basis Threat' (DBT) document in which more attention is paid to digital threats to the LHs. This updated DBT forms the input for an update of the security packages of the LHs in which they show how they withstand the various threats in the DBT, which thus reflect the increased threat of digital attacks.

8.2(c) Reporting obligations

The ANVS reports to the Minister of I&W about its functioning. The Minister of I&W 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 ongoing issues of interest for politics and the general public about nuclear safety and radiation protection in the Netherlands. In this letter, reference may be made to the ANVS website for further information or publications. Everything reported in Parliament is immediately available on the government website www.overheid.nl and is therefore available to any interested party. The ANVS publishes their annual report.

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

The ANVS has extensive files on many issues published on its website, featuring many in-depth studies on issues related to nuclear-related activities. Information on all major LHs can be found online too. This is part of the policy on transparent governance. Also refer to section 8.1.i for information on 'Openness and transparency of regulatory activities'.

8.2(d) Separation of protection and promotion

The ANVS is not involved in energy policies and has no legal tasks regarding these policies. Its involvement with nuclear power is restricted to nuclear safety and radiation protection and associated issues. Development of energy policies is carried out by the Minister of Climate Policy and Green Growth.

8.3 Summary of Responses to Applicable Challenges and Suggestions

The ANVS is able to manage the workload and attract a significant number of new employees. The ANVS has a multi-year capacity building plan – broken down into function groups – to facilitate this growth. A new traineeship programme is also starting in September 2025. The ANVS Academy meanwhile offers training and tutoring opportunities for new workers and personal development options for existing workers. In 2023 the state issued an updated 'Design Basis Threat' (DBT) document in which more attention is paid to digital threats to the LHs.

8.4 Summary of Significant Changes Since Previous Report

Article 8

- Further expansion of communications activities by the ANVS.

- Participation of ANVS employees in various IAEA missions.
- Further growth of the ANVS in employee numbers from 121 FTE in 2021 to 176.8 FTE in 2024.
- In 2021 a contract was signed by the ANVS with a consortium of Bel V, ASNR and Bureau Veritas from Belgium and France, for a minimum of ten years.
- Launch of the ANVS Academy in 2022.
- Publishing of State of Nuclear Safety Document by the ANVS in 2022.
- Change of the internal ANVS structure in 2023.
- Release of Design Basis Threat Document by the state in 2023.
- Organisation by the ANVS of European Regional IAEA Regulators Workshop on SMRs in 2023.
- New cooperation agreements signed with Regulatory Bodies of South Africa (2023), France (2023), UK (2024), South Korea (2024) and Poland (2024) by the ANVS.
- The Netherlands received IRRS, ARTEMIS and IPPAS missions in 2023.
- Start of ANVS Integrated Management (AIM) Programme in 2023.
- Start of Nuclear Academy in 2023 by NRG and Delft University of Technology.
- Launch of a new programme to develop a new case management system of the ANVS as well as to improve information-based work by the ANVS (programme BOSON) in 2024.
- Hosting of annual KWUREG meeting in 2024 by the ANVS.
- Start of use of Publication Platform Implementation Content (PUC) by the ANVS in 2024.
- Formalisation of transfer of responsibility for task 'Evaluating and preparing policies, acts and regulations' to the Ministry of I&W by change in Nuclear Energy Act in 2024.
- Launch of the ANVS traineeship in 2025.

8.5 Notable Achievements

- Facilitation of growth in coming years at the ANVS facilitated through multi-year capacity building plan.
- Launch of ANVS traineeship in 2025.
- New cooperation agreements signed with Regulatory Bodies of South Africa (2023), France (2023), UK (2024), South Korea (2024) and Poland (2024) by the ANVS.

8.6 Future Focus

- Attract and train additional new employees at the ANVS to realise the growth ambitions, whilst simultaneously taking care of the absorptive capacity of the organisation and retention of current employees.

Article 9. Licence holders

9 Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such Licence Holder meets its responsibility.

The Kingdom of the Netherlands fulfills the obligations of Article 9.

9.1 Regulatory basis

The responsibility of the Licence Holder (LH) emerges from the principles of the Dutch legal system, including the Nuclear Energy Act and underlying regulations, and the obligations referred to therein for the LH. The principle that the ultimate responsibility for safety lies with the LH is established in the legislation at several levels. This is explained further below.

9.1(a) Transposition and implementation of European Directives

As mentioned in the text on Article 7, the Netherlands has implemented 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 lies with the LH.

In Article 3 of the Ministerial Nuclear Safety Regulation for Nuclear Installations, implementing Directive 2014/87/EURATOM, the LH's 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 (article 6) and pursue continuous improvement (article 11 (1) and (2)). 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 (article 3 (2) and (3)). The regulation also contains requirements about transparent communication to the public, by the RB (article 17) and LHs (article 5).

9.1(b) Nuclear Energy Act

Article 70 of the Nuclear Energy Act specifies that a licence issued according to this Act is personal. In case of a licence transfer on the basis of this article, it is required 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.

The responsibilities accompanying a licence can only be transferred to another person with permission from the ANVS. Conditions may be imposed on the transfer of the licence to a third party. This enables the ANVS to assess whether the potential new LH meets the same standards as the previous LH. In late 2024 guidance was published by the ANVS that provides further insights into the associated processes.

9.1(c) Governmental Decrees

A further elaboration can also be found in the Governmental Decree on Basic Safety Standards for Radiation Protection (Bbs), as the LH is required to keep exposure of the population and workers as a result of its activities as low as reasonably achievable (article 2.6). There are many regulations in the Bbs that specify "The operator ensures that…". The Bbs also includes requirements with respect to the competence of the operator or LH.

9.1(d) Licence conditions and WENRA reference levels

The licences for the nuclear installations contain conditions that require the LH to regularly evaluate the nuclear safety and radiation protection, and to report on those issues to the ANVS. The licence also states that the LH must review the safety of the plant at both two-yearly and 10-yearly intervals (Periodic Safety Reviews, PSRs). These PSRs are subject to regulatory review. Safety evaluations are described in more detail in sections on other articles of the Convention. Refer to the section on Article 10 'Priority to Safety' of the Convention for further details.

Nuclear installations must have an adequate management system among others describing verification procedures. There is also a Nuclear Safety Rule NVR GS-R-3-which formulates these requirements in general terms. Also refer to the text on Article 13 'Quality Assurance' of the Convention. The LH's own Management System and internal verification organisation are important mechanisms enabling the LH to adhere to the licence and achieve its corporate safety objectives.

The latest version of WENRA Reference Levels (RLs) has been implemented in the licence conditions of Borssele NPP, including RLs that deal with the LH's responsibilities for the contractors activities. In the licence of Borssele NPP, as a licence condition the NVR NS-R-2 a Dutch application of the IAEA document is applicable. Several articles in this NVR deal with the responsibilities of the operating organisation with respect to safety.

The ANVS is working on a new approach to implement the IAEA requirements and the WENRA SRLs in a systematic way. In the near future, the IAEA requirements will be attached to the licence, by reference in the licence conditions. This means the Nuclear Safety Rules will no longer be used. IAEA guidance documents and the WENRA SRLs will be implemented through an ANVS guidance document.

Other obligations

With the covenant of 2006, the LH of the Borssele NPP has agreed to ensure that Borssele nuclear power plant continues to be among the twenty-five percent safest water-cooled and water-moderated power reactors in the European Union, the United States of America and Canada.

9.2 Supervision and enforcement of compliance

Compliance with the licence and its terms is monitored by the ANVS by means of an appropriate supervision programme. The policy on supervision and enforcement, including its guiding principles, is described in further detail in sections on Article 7 'Legislative and Regulatory Framework', especially section 7.2 'Provision in the legislative and regulatory framework' and sections on Article 10 'Priority to Safety, among others in section 10.1.c 'Supervision of priority to safety'.

The supervision programme includes international safety missions. Periodic safety missions at the NPP are carried out at the request of EPZ (such as WANO Peer Reviews and Technical Support Missions). In preparation of the mission, often the LH conducts a self-assessment. The ANVS has always access to the results. The ANVS adds to this programme its own missions, in agreement with the LH. The most important one being the ten-yearly OSART mission.

9.3 Emergency preparedness

The LH needs to have appropriate resources (technical, human, financial) and powers for the effective on-site management of an accident and mitigation of its consequences. This is described in some detail in the texts on Article 16 'Emergency Preparedness'.

9.4 Public communication

9.4(a) General

The regulation MR NV, implementing Directive 2014/87/EURATOM of 8 July 2014 includes requirements about transparent communication to the public by the LHs.

All LHs have a communication policy towards public communication specially developed for the general public. Prime means of communication are the websites of the LHs. Special developments, incidents and

other news related to their activities are published on these websites. Some LHs will use press conferences, meetings and interviews as well. The LHs of nuclear installations also fund an association that on a central website[63] provides information to the public about topics related to the application of nuclear technology, nuclear safety, radiation protection et cetera.

9.4(b) Communication by the Borssele NPP

EPZ has adapted its communication policy towards public communication developed specifically for the general public. EPZ recognises its obligation to communicate openly about the company and its plants to the general public with factual, reliable and understandable information. Its communication has been being changed from 'sender-oriented' to 'receiver-oriented'. Article 5 of the Ministerial Nuclear Safety Regulation for Nuclear Installations contains requirements about transparent communication to the public.

Its prime means of communication is its web site, but press conferences and interviews are used as well. Its website layout and structure has been improved for easier access to its information. Information is categorized and targeted to the general public. Categories include Nuclear Power Plant, Dismantling, Security and Safety. Publications include the formal event notifications to the regulator, OSART reports, Annual reports, progress on safety modifications and information on outages.

EPZ also promotes visits to its information centre and plant tours, albeit still legally limited to adults with work-related objectives.

[63] https://nucleairnederland.nl

Article 10. Priority to Safety

10. Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

The Kingdom of the Netherlands fulfills the obligations of Article 10.

10.1 Policy on nuclear safety

10.1(a) Regulatory requirements and implementation

Refer to the text on Article 7 of the Convention for an overview of the regulatory framework.

The whole process of the design, construction, operation, and decommissioning of a nuclear facility in the Netherlands (as well as the licensing of all these stages) is characterised by priority given to nuclear safety at all these stages of the lifecycle of such a facility. This is laid down in the Nuclear Energy Act, which requires (Art. 15c) that licence conditions shall be put in place in order to provide for the best possible protection against any remaining adverse consequences of operating a nuclear facility, unless this cannot be reasonably required.

In the licence of the NPP, a requirement is to comply with the Safety Requirements for nuclear power plant operation, NVR R-2 (Safety of Nuclear Power Plants: Operation Safety Requirements). This document requires that the operating organisation must be aware of the special emphasis that needs to be placed on safety when operating nuclear power plants. This special emphasis and commitment to safety must be reflected in the organisational structure.

NVR NS-R-2 also states that plant management has a direct responsibility for the safe operation of the plant. All safety-relevant management functions, such as decisions on financial, material and manpower resources and operating functions, must be performed and supported at the most senior level of management.

NVR GS-R-3 together with the Ministerial regulation on implementation of the European Nuclear Safety Directive required the LH to establish a management system where priority to safety is paramount.

The Ministerial regulation on implementation of the European Nuclear Safety Directive includes the requirement to continuously improve nuclear safety. To aid LHs and applicants, the ANVS has published a guidance document on continuous improvement. It refers to international guidance document - mainly IAEA documents.

10.1(b) Licence Holder's (EPZ's) policy and organisation

The policy plan of the Borssele utility describes the priority attached to safety in relation to that given to financial considerations as follows:

'EPZ is a producer of electricity. Nuclear an industrial safety are our highest priorities and that is visible in all our activities. The operations are optimally tuned to the demands of our customers and socially responsible.'

In addition, the following policy statement can be found in the objectives of the Management System of the Borssele NPP:

"Operation consists of a safety function, i.e. maintaining and improving operational and nuclear safety, and an economic function, i.e. producing electricity. The economic function will only be fulfilled if the nuclear power plant is safe, from a process and technical viewpoint, and if the safety function is being

fulfilled in an adequate manner. The 'conditions for operation' and the 'limits' as laid down in the Technical Specifications must be fulfilled at all times."

The Plant Manager (PM) bears full responsibility for nuclear safety and is responsible for the economic production in accordance with the licence and with nuclear safety as overriding priority. The PM has power of enforcement should nuclear safety or radiation protection be challenged. A full-time Radiation Protection Specialist (Algemeen Coördinerend Deskundige, f) oversees the occupational radiation safety of the workers. In addition, a separate Occupational Health Specialist oversees the conventional safety of the workers.

The internal nuclear safety review board (RBVC) advises the PM on nuclear safety and radiation protection issues. The PM reports directly to the CEO. This ensures that safety is given a proper role in this economically-oriented environment.

The external nuclear safety review board advises the CEO on nuclear safety and radiation protection issues and on industrial safety issues.

EPZ has several independent bodies to support top management with respect to (nuclear) safety, radiation protection and (radiological) environmental issues. The most important ones are listed below.

ACD	The highest level radiation protection officer. Person formally responsible for radiation protection at EPZ. Is allowed to advise the CEO.
ALARA Committee	Its function is to advice the RP manager on Radiation Protection issues.
RBVC	Internal Nuclear Safety Committee. Its function is to advice the PM on nuclear safety and RP-issues.
ERBVC	Its function is to advice the CEO on organisational issues, in particular by evaluation of the nuclear safety performance of the plant and the performance of the RBVC.
NV&KZ	Nuclear Safety & Quality Assurance department. This is a dedicated department for independent supervision on nuclear safety, radiation protection and quality assurance. Its manager reports directly to the CEO of the company.
NVD	Nuclear Safety Officer for Independent Oversight. Is allowed to advise the CEO.
Advisor nuclear safety	Staff employee serving the CEO, advising the CEO on issues related to nuclear safety.

Where new safety insights emerge, their relevance to the NPP is scrutinised and modifications are initiated if they are found to offer sufficient safety benefits to justify their cost.

Practical experience (such as the major backfitting programme at Borssele) has shown that the modifications have comfortably met the criteria applied in other countries. There is an ANVS Guidance document on 'continuous improvement'. EPZ has implemented this in its policy, including its cost-benefit policy.

As already mentioned, regular safety improvements have to be performed under EU regulations regarding continuous improvement. At two-yearly intervals the operation of the plant must be evaluated against the existing licence requirements and at 10-yearly intervals a thorough safety evaluation against modern safety requirements and current safety insights on technical, organisational, personnel and administrative aspects. These Periodic Safety Reviews (PSRs) and the resulting improvement or modification projects are aimed solely at further improvement of plant safety.

The LH (EPZ) of the Borssele plant is a member of WANO. The CEO of EPZ is member of the board of WANO Paris centre. Further EPZ is member of the Framatome Owners Group, the PWR Owners Group and the German VGB, which provide a valuable source of information. Staff takes an active part in international WANO and IAEA missions.

10.1(c) Supervision of priority to safety

The policy on supervision and enforcement has been described in the text on Article 8 in section 8.1.e and to somewhat more detail in the sections: 7.2(c) System of regulatory assessment and inspections' and 7.2(d) Enforcement of applicable regulation and terms of licences'.

Implementation of supervision of priority to safety

In the execution of its supervision and enforcement, the ANVS strikes a careful balance between proactive and reactive oversight. Periodically, the ANVS evaluates this balance. In the various sectors, the balance will be different. With nuclear facilities like NPPs, the oversight will be more proactive, given the potential impact of imaginable incidents associated with their operation. Risks that are difficult to detect beforehand but have limited potential impact may be best met with a reactive approach.

In the supervision of priority to safety at the NPP, the ANVS first pays attention to developments at the NPP with respect to the annual plan, management, nuclear leadership and position of shareholders to make sure that safety is properly prioritised. Secondly the ANVS pays attention to subjects and events the NPP organisation declares as purely economical. The ANVS assesses the assumption of the NPP that safety aspects play no role in the subjects or events concerned. Finally the ANVS continues to emphasise the importance of periodic safety reviews (PSRs), continuous improvement and the prioritisation of the implementation of measures with a higher positive safety impact.

Some more detailed examples of the practice of supervision are:

- Justifications of continued operation and their evaluation by the ANVS.
- Temporary modifications and their evaluation by the ANVS.
- Issues of gradual degradation, although the safety requirements keep being met. In these cases the ANVS will urge the LH to act and restore to the original situation.

The independent bodies and functions that advise the plant manager and the CEO on nuclear safety and radiation protection have been mentioned above. Their tasks and authorisations are documented in the Technical Specifications and/or in procedures that require authorisation of the Regulatory Body.

Organisational aspects are relevant for nuclear safety. The global description of the NPP organisation, including specifications of competences and authorities for key staff, is part of the Technical Specifications. On top of that there is a licence condition to submit a safety case for organisational changes with safety relevance and it is therefore subject to regulatory review and inspection.

Regulatory Experience Feedback (REF) to improve supervision

The ANVS's policy and ambition is to closely follow international safety developments by participating in several international committees. The information is amongst others used to improve its primary functions, including supervision programme, and to evaluate the safety insights and improvements that the NPP organisation is proposing.

As an illustration of the high priority given to safety, it is worth mentioning that the Netherlands participates actively in the Incident Reporting System and have bilateral contracts with neighbouring countries Belgium and Germany and exchanges within the KWUREG group with regard to the evaluation of incidents.

10.2 Safety culture at the Licence Holder

10.2(a) Requirements

Basic requirements are adopted from EU safety directive (MR-NV). At the NPP, NVR GSR Part 2 is applicable as part of the PSR, but is not yet part of the licensing base. Since 2020 GSR Part 2 is applicable to the HFR. In any case the current IAEA standards are used as a reference in the PSRs, as well for those installations that receive IAEA missions.

Examples of implementation are given on the next page, regarding the NPP and the HFR.

10.2(b) Safety culture at Borssele NPP

The staff of the Borssele NPP is aware of the necessity of having safe working conditions and practices to avoid any harm to humans, installation or environment. The policy is to execute no activity until it is ensured that it can be done safely. Integrated risk analysis, procedures, instructions, checklists, training programs, etc. have been developed to ensure that important safety considerations are not forgotten or overlooked when planning and carrying out the work. Pre-job briefings and last minute risk assessments are used as last safety barriers and independent safety inspectors are employed for monitoring and oversight.

Safety performance is monitored and evaluated by the LH to discover underlying causes and trends. In addition, independent safety assessments, like reviews by safety specialists from peer companies, are used to identify areas for improvement. Also WANO peer reviews and OSART missions contribute to further improve LH's safety culture.

The OSART mission in 2014 was combined with an ISCA module (Integrated Safety Culture Assessment) and a Corporate OSART module (assessment of the role of the top-management of EPZ). Important areas for improvement which were identified during the peer review included: leadership, performance measurement and operating experience. Since then, action plans have been developed and implemented by LH in areas such as reinforcement of management expectations, strengthening ownership and improving risk awareness, supported by a restructuring of the management system to strengthen the continuous improvement cycle.

Management expectations have been evaluated, simplified and clarified. They now stem from the following top-level expectations:

- We always give priority to nuclear safety.
- We either work safely or we stop.
- We adhere to rules, procedures and what we have agreed.
- We use human performance tools to do our work safely.
- We cooperate, share knowledge and experience, and encourage improvement.

Weekly themes address a specific expectation, often based on planned activities or recent observations.

The human performance programme has been improved and undergoes continuous improvement to better support the management expectations.

The OSART Follow-ups in December 2016[64] and 2017[65] are independent reviews of safety culture. The teams noted significant progress in safety culture related programmes, such as the Culture for Safety, Leadership for Safety and Human Performance programmes. Improvements were evident in safety related indicators and confirmed by the team in areas such as openness and trust, communication, use of operating experience, work practices and in radiation safety.

In 2023[66], the LH received an OSART mission again. During this review, the OSART team highlighted a total of 11 findings—comprising three recommendations and eight suggestions. Additionally, six good practices were acknowledged. Among the most important issues were the use of unauthorised operating aids and documents, the need for enhanced radiation protection measures related to contamination control, dose planning, and management of radioactive sources, as well as improvements in chemical

[64] Report of fist stage follow-up of OSART mission can be found at the ANVS website: https://www.autoriteitnvs.nl/binaries/anvs/documenten/rapporten/2017/09/14/report-of-the-osart-mission-to-epz-and-first-stage-follow-up-mission/report-of-the-operational-safety-review-team_2016.pdf

[65] Report of second stage follow-up of OSART mission can be found at: https://www.autoriteitnvs.nl/binaries/anvs/documenten/rapporten/2018/05/02/eindrapport-osart-missie/OSART+rapport.PDF

[66] Report of the 2023 OSART mission can be found at: IAEA report OSART review Borssele nuclear power plant 2023 | Report | Authority for Nuclear Safety and Radiation Protection

control procedures. In response, the LH has taken steps to resolve the identified issues. A follow-up mission took place in 2025.

10.2(c) HFR

The last INSARR was in 2016. In addition in 2017 also an ISCA mission took place at all operational entities of NRG, including the HFR. The IAEA team noted several efforts to enhance safety and safety culture within the organisation and found the workforce at all levels open, approachable and willing to discuss safety. There were still various areas with elements of them in need of attention. The most important areas concerned were Leadership, Management System, Nuclear Safety and Safety Culture Attention, Training and Competence, Communication, Interactions, Workload and Resources and Committee roles, independent review and quality assurance. In April 2019, in parallel INSARR and ISCAR follow-up missions were conducted and good progress was noted.

10.2(d) Supervision of safety culture

Inspections performed by the ANVS to measure safety culture, including monitoring LH's attitude to safety, are based on MR-NV article 8. The ANVS expects the LH to conduct a programme that is developed and regularly evaluated and accordingly updated to promote and sustain safety culture.

The ANVS has integrated safety culture in the supervision programme using IAEA guidance.

There are yearly meetings with the LH about achievements and development of safety culture and human performance. The scope of these meetings also covers organisational issues.

Safety culture is also a subject of the OSART missions initiated by the ANVS as mentioned in section 10.2(b). The drastic positive changes that the NPP had gone through in the period after the OSART/ISCA mission in 2014 was remarkable. For the ANVS it was important that these changes were structural and therefore it was monitored in the years after. On initiative of the ANVS, together with EPZ, the issue and new approach were presented from both sides in a number of fora: German RSK and CNRA Special Topic.

In the past there have been safety culture problems at the HFR in Petten that were remedied by the LH, NRG, with a dedicated programme. More attention had to be given to a more systematic approach of safety culture, external assessment of safety culture and a more consistent approach of safety culture on corporate level. To monitor improvements, throughout the years there have been audits by the Regulatory Body and various IAEA missions. October 2016 saw an INSARR mission, which also contained a safety culture module. June 2017 a dedicated IAEA Independent Safety Culture Assessment mission (IAEA-ISCA) was conducted at a broader part of NRG's organisation, namely the whole of the NRG Operations, interfaces with supporting groups and all layers of management.

Appendix 5 contains more information about the HFR.

10.3 Leadership and management of safety (including monitoring and self-assessment)

10.3(a) Requirements

Main requirements are recorded in the MR-NV and NVR-GS-R3; this NVR is referenced in the licence of Borssele NPP.

10.3(b) Self-assessment by the LH (of Borssele NPP)

Organisational aspects have been described in section 10.1(b).

Self-monitoring of the processes of the Management System is mostly based on performance indicators. The LH has enhanced and expanded its indicator monitoring system. New and enhanced indicators monitor performance of culture-related aspects such as the use of Operating Experience, the use of Human Performance Tools, Leadership, Internal Oversight, Risk Management and Communication.

Relevant self-assessments include:

- Periodic Process Performance Reviews, based on performance indicators, corrective actions and incident reports.
- Quarterly observation reports from the LH's Nuclear Safety & Quality Assurance department.
- Yearly reports and evaluations of processes and plant performance, such as operational experience feedback, emergency preparedness and response, surveillance and in-service-inspections, fatigue monitoring (part of ageing management), radiation protection, radiological releases, and radioactive waste. (some of them are a licence condition).
- Two-yearly evaluation.
- Ten-yearly periodic safety reviews.
- The NPP's Nuclear Safety & Quality Assurance department's programme for inspection and audits.

Independent safety assessments invited by the plant include WANO Peer Reviews and WANO Technical Support Missions. The regulator invites the IAEA, for OSART, SALTO, IPPAS, and IPSART missions. In the recent past also the ENSREG Topical Peer Reviews (TPRs) were introduced. The TPRs will every sixth year address a new topic.

The text on Article 13 in the present report provides information on the restructuring of LH's integral management system.

10.3(c) Supervision of safety management

The assessment of the integrated safety management system (IMS) of the Licence Holder is part of the ANVS' surveillance programme. The ANVS pays attention to effectiveness of the safety management system during the assessment of changes of the organisation and/or procedures and during incident analyses. A strong safety culture at the LH is an important topic in the oversight exercised by the ANVS. Further reference is made to the text on Article 13 in the present report.

10.4 Safety culture at the Regulatory Body

The Netherlands has transposed the European Nuclear Safety Directive, which has various requirements for administrative bodies like the ANVS. Among others, it requires an effective nuclear safety culture.

The importance of an effective safety culture within the RB is also secured as a policy statement in the main organisational document of the ANVS, the ANVS Integral Management document (AIM, refer to section 8.1.i). The OECD/NEA Green Booklet 'the Safety Culture of an Effective Nuclear Regulatory Body' is leading for the ANVS and contains the principles and attributes for the safety culture of an effective nuclear Regulatory Body. We also use the IAEA Harmonized Safety Culture Model.

The ANVS's mission states: "The Authority for Nuclear Safety and Radiation Protection (ANVS) is independent and professional; it continuously monitors and promotes nuclear safety, radiation protection and security for this and future generations". In addition, six leading principles for the organisation were defined: "safety first; individual responsibility and justified trust; continuous improvement; risk oriented; separation of functions/roles; connecting". With reference to these guiding principles, the ANVS has implemented several elements of safety culture, such as the open-door policy, feedback on the results of weekly management team meetings, employee perception surveys and other organisational topics in the 'ANVS weekly update'. Additionally, the ANVS has adopted other measures to promote safety culture, such as the introduction of shared vocabulary, periodic integrity surveys, creation of a confidential counsellor and reinforcing the application of the Whistle Blower Authority Act.

Furthermore the ANVS participates as a member in the OECD/NEA Committee on Nuclear Regulatory Activities (CNRA) and its Working Group on Safety Culture (WGLSC). The ANVS has an internal safety culture working group addressing safety culture and it also develops interactive sessions to educate staff on safety culture issues. The working group will summarise emerging safety culture related themes and present them to management to promote awareness of important topics.

In 2023 and 2024,the integrity coordinator and confidential advisor held dilemma sessions to strengthen awareness of integrity and inappropriate behaviour within the organisation. In mid-2025 safety culture

meetings were organised for all ANVS employees. Furthermore, a formal policy statement regarding safety culture was signed by the ANVS Board and by the Directors in June 2025.

Article 11. Financial and Human Resources

11.1 Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

11.2 Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety related activities in or for each nuclear installation, throughout its life.

The Kingdom of the Netherlands fulfills the obligations of Article 11.

11.1 Adequate financial resources

11.1(a) Dynamics of the power market

In recent decades, electricity companies have had to adapt to the demands of politics and society as well as to technical challenges and new economic realities. Examples of such factors influencing their development include: liberalisation of the electricity market, changing fossil fuel prices, changing wholesale prices, low interest rates, climate concerns, growth in the share of renewable energy, special developments in ICT, and safety requirements.

Liberalisation of the power market and regulatory attention

Prompted by EU legislation, the EU member states have restructured their electricity sector to allow for more competition. The objective is to achieve a well-functioning European electricity market which delivers on access to competitive electricity prices, on security of supply and ensuring investments. As a result of these developments the electricity sector has seen the formation of alliances and mergers.

Wholesale prices seem to remain volatile. There have been falls in wholesale prices, even below production costs. In other periods, prices have risen again to profitable levels.

it is obvious that in all EU countries including the Netherlands, the European electricity market has introduced new dynamics with an increase in the interest in commercial and economical aspects. Therefore regulatory attention to the relationship between production, financial aspects and safety is continuously required.

Unbundling

In the past, the electricity markets were almost completely controlled by the electricity companies with large, vertically integrated utilities that used to be regulated by state monopolies. These companies typically owned almost all generators, as well as transmission and/or the distribution network. The EU's executive body has been a strong advocate of unbundling generation and network activities to prevent these companies from using their influence to reduce competition. Several EU countries are opposed to full unbundling. As a compromise, European states are free to choose from several options to promote competition. In the Netherlands, unbundling was completed in 2017.

Tolling agreement Dutch NPP

Operator EPZ has a tolling agreement with its shareholders to cover the cost of electricity production, including investments and funding for decommissioning. The abovementioned past downward development in electricity market prices affected the profitability of the electricity production by the Borssele NPP and this posed a large challenge to its owners (PZEM and Essent). For a couple of years

losses on the electricity produced by EPZ had to be accepted. The final decision on unbundling in the Netherlands has led to a change in the ownership of EPZ.

The former 70% shareholder Delta was forced to split into three parts, where two parts were sold and one part renamed itself firstly into PZEM and later in ZEH. ZEH now is the 70% shareholder of EPZ. ZEH itself is owned by the local Province of Zeeland and a number of communities.

11.1(b) Legislative aspects of ownership and responsibility

The principle that the ultimate responsibility for safety lies with the Licence Holder (LH) is laid down in several layers of regulation. More about this can be found in the text on Article 9.

The Nuclear Energy Act contains a number of articles, which deal with criteria, interests and conditions under which a licence can be awarded. The explanatory memorandum on Article 70, which states that a licence is to be awarded to a corporate body, refers to guarantees of solvability, necessary expertise, and trustworthiness in relation to safety.

The licence does not automatically pass to the LH's successor in title. In the case where major changes in ownership of EPZ (LH of the Borssele NPP) would be planned, the LH is obligated to inform the Regulatory Body three months in advance. Article 70 of the Nuclear Energy Act stipulates that any transfer of ownership must take place with the consent of the Regulatory Body. This allows the Regulatory Body to assess whether a potential new LH can meet the same standards as the previous one.

The case of change of ownership is not a theoretical one; the abovementioned changes regarding the shareholders of EPZ presents such a case. Changes in shareholders and a transfer of shares between them have resulted in a majority shareholder (public company, with 70 %) and a minority shareholder (private company, with 30%). The changes in shareholders have led to the conclusion of an agreement between the shareholders and the Dutch government on public interests concerning the (shares in) the nuclear power plant ("convenant publieke belangen kerncentrale Borssele"). The agreement, among others, concerns safeguards on public interests when operating the power plant and sets criteria and procedures to follow should a shareholder wish to transfer (part of) its shares.

11.1(c) Rules and regulations on financial resources for safe operation

Based on the EU-Directive on Nuclear Safety a requirement of adequate financial resources is included in the Dutch regulations (Ministerial Order on Safety of Nuclear Installations, MR-NV). The regulation (in its article 4) requires the LH to have sufficient human and financial resources.

Furthermore, the licence contains conditions referring to various regulations with clauses implicitly requiring sufficient financial resources to ensure nuclear safety. For instance the LH is required to be able to cope with costs of safe operation. The management of the NPP must act promptly to provide adequate facilities and services during operation and in response to emergencies too. Also, the personnel involved in reviewing activities have to have sufficient independence from cost and scheduling considerations. This applies to reviews of all safety-related activities.

11.1.c.1 Financing of safety improvements at Borssele NPP

A major policy principle of the LH of the NPP is the overriding priority of nuclear safety. This includes that LH's management will act promptly to provide adequate facilities and services during normal operation and in response to emergencies.

The LH's policy is part of the EPZ corporate plan. The corporate plan comprises a period of three years and is drawn up every year. They are presented to the corporate shareholders for approval. One of the main programmes in the corporate plans is the continuous enhancement of the nuclear safety on the power plant. From the corporate plan every year there will be written an annual plan for implementing the programmes.

Before those annual plans will go to the shareholders, they have undergone an internal budgeting process to finance the programmes for that year. During that budgeting process the Quality Assurance

Department will see to it that the budgeting process does not have negative consequences for nuclear safety.

According to the licence the LH has to do a periodic safety review every two years (checking compliance with the current licence conditions) and a more thorough safety evaluation (comparing with the state-of-the-art) every ten years. In the 10 yearly evaluations, the evaluation points will be assigned with safety significance on basis of:

- A deterministic approach described in the NVRs and IAEA Safety Standards;
- A probabilistic approach (PSA) with emphasis on the significance for the core damage frequency and individual risks;
- Considerations from the perspective of radiation protection for workers, the public and the environment;
- The defence-in-depth approach according to INSAG 10.

This evaluation will result in a list of possible actions to improve the safety. On a basis of cost-benefit considerations, it is decided which measures from that list will be implemented within a certain timeframe. Also refer to the text on Article 10 in the present report.

11.1.c.2 Improvements to the radiation safety programme; regulations and arrangements regarding financing decommissioning

According to legislation in force since July 2011, decommissioning of a nuclear facility shall commence directly after final shut down, and carried out without undue delay (no safe enclosure)[67] . Decommissioning implies the implementation of all administrative and technical measures that are necessary to remove the facility in a safe manner, and to create an end state of 'green field'. Therefore, the LH is required to develop a decommissioning plan, describing all the necessary measures to safely reach the end state of decommissioning, including the management of radioactive waste. This decommissioning plan shall be periodically updated, and shall be approved by the Regulatory Body.

The legislation also requires the LH of a nuclear reactor to ensure the availability of adequate financial resources for decommissioning at the moment decommissioning begins. It is approved by the Minister of I&W and the Minister of Finance.

Also refer to the text on Article 7 of the Convention for more details on current legislation.

11.1.c.3 Regulations and arrangements regarding financial resources for waste management

The Netherlands' policy on the management of radioactive waste and spent fuel is to isolate, control, and monitor radioactive waste in above ground structures for an interim period of at least a hundred years, after which geological disposal is foreseen. During the period of interim storage all necessary technical, economical, and social arrangements are to be made in such a way that geological disposal can be implemented in due time.

Implementation of this policy lead to the establishment of COVRA, the Central Organisation for Radioactive Waste, located in the municipality Nieuwdorp. COVRA is a 100% state owned organisation, and is the only organisation allowed to manage and store the radioactive waste and spent fuel. Upon transfer to COVRA, COVRA takes over all liabilities, including the responsibility for final disposal. This way no (perpetual) claims remain on companies whose long-term existence is uncertain.

The 'polluter pays' principle is fulfilled by the fact that COVRA charges the generator of the waste for all costs, including costs for processing, storage and final disposal, on the basis of the state-of-the-art of the knowledge.

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[67] The NPP Dodewaard, brought into a state of Safe Enclosure in 2005, is excluded from this requirement

For more information on waste management issues, refer to our national report for the 'Joint Convention on the Safety of Management of Spent Fuel Management and on the Safe Management of Radioactive Waste Management'.

11.1(d) Statement regarding the adequacy of financial provision at the NPP

Currently, the financial provisions of the LH of the NPP, EPZ, seem adequate to fulfil its regulatory requirements, as long as the owners of EPZ provide the financial means needed according to the tolling agreements. This is explained below.

Nuclear safety has overriding priority within the company and LH EPZ. Its shareholders are aware of the importance of high performance in nuclear safety. Costs for safety improvements are considered as an integral part of the operation costs. A high safety level, demonstrated by a good safety record is considered as an essential component of the business concept.

EPZ annually invests 5-20 M€ of which 30%-60% is safety related. Investments necessary for (improving) safe operation are not evaluated on a commercial or economical basis. From EPZ's and its shareholders perspective, safety-related investments are a duty of a nuclear operator and a licence to operate instead of a possibility to decide on.

Up to now EPZ has been allotted enough financial resources for maintaining the appropriate level of nuclear safety by its shareholders. The price of a kWh of electricity produced in the EPZ NPP is set out by the management and approved by the shareholders (who are also the only customers), based on the yearly business plan. Such a price covers all gross operating expenses, i.e. electricity generation costs as well as necessary investments. Besides this, the shareholders annually approve the Long-term Investment Plan.

The adequacy of EPZ's financial system and internal controls are assessed by an external auditor. According to the safety and security charter, the management hereby is committed to provide all necessary financial means to enhance safety and to ensure all required security measures.

11.1(e) Supervision of financial arrangements and provisions

As mentioned above, EPZ's financial system and internal controls are assessed by an external auditor.

The sufficiency of the budget of the LH for safety has become a more prominent topic of interest in recent years. The subject is discussed during periodic management meetings and also in the case of larger investments, e.g. improvements stemming from the periodic safety review.

The ANVS has developed a risk-based approach to examine the sufficiency of liquidity and solvency to run safely the installation. It is planned that this approach will be used to perform inspections in cases where the financial situation seems to be an area of attention. These inspections will focus on the financial situation, the governance and the systems for decision making (planning and control).Detailed planning depends on availability of staff, see also 8.1(g).

Decommissioning funding, is assessed by the Ministry of I&W in cooperation with the Ministry of Finance.

11.2 Human resources

11.2(a) Legislative aspects

The Nuclear Energy Act stipulates that an application for a licence must 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. In the last years the transposition of the EU-Directive on nuclear safety has reinforced the requirements on adequacy of human resources in MR-NV article 4. The LH shall see to it that his staff has the required expertise and skills. This requirement extends to staff of contractors, acting under the responsibility of the LH. Article 8(2) of MR NV details these requirements somewhat further and also addresses safety culture. Article 10 states the LH needs to have documentation on its education and training policy, as well an associated plan for the education and

training of its staff. On-site emergency preparedness is explicitly mentioned as a training subject in Article 10. The documentation shall be regularly evaluated and updated to reflect internal and external developments related to nuclear safety.

The Decree on Basic Safety Standards Radiation Protection (Bbs) also imposes requirements on the competence of the staff. More information on regulatory requirements on the level of Acts and MR NV can be found in the text on Article 7 in the present report.

NVR-GS-R-3 'The Management System for Facilities and Activities' requires of the management of the organisation that it makes available those resources needed for correctly implementing the activities of the organisation. Resources also include the human resources needed to comply with the obligations in respect of nuclear safety of the nuclear installation under the authority of the LH.

The requirements regarding competence of staff, extend to those of contractors or sub-contractors.

The surveillance programme of the ANVS includes human resources. The LH's number of staff, their education, their training and their experience are being assessed periodically. Safety-relevant changes in organisation and staff must be approved by the ANVS.

The ANVS in overseeing the compliance of the LHs, regularly pays attention to the management systems of the LHs, and how these are applied to hiring contractors.

Licence conditions Borssele NPP

In the licence of the Borssele NPP reference is made to NVR NS-G-2.8 (Dutch application of IAEA NS-G-2.8) and the specific Safety Guide NVR 3.2.1 for licenced control room personnel.

The safety relevant part of the organisational structure of the plant is described in the Technical Specifications, with clear details of the responsibilities, authority interfaces, lines of communication, requisite level of expertise, and the requirements for training and education. It is therefore part of the licence, and hence subject to inspection by the ANVS. Another part of the licence is that any planned organisational change with possible safety relevance, must on forehand be reported to the authorities.

Under NVR-NS-G-2.8 the responsibility for ensuring that individuals are appropriately qualified and remain so rests with the operating organisation. It is the responsibility of the plant manager, with reference to each position having importance to safety to ensure that:

- The appropriate qualification requirements are established;
- The training needs are analysed and an overall training programme is developed;
- The proficiency of the trainee at the various stages of the training is reviewed and verified;
- The effectiveness of the training is reviewed and verified;
- The competence acquired is not lost after the final qualification;
- The competence of the persons occupying each position is periodically checked and continuing training is provided on a regular basis.

The LH has to submit its education and training plan for its control room staff to the RB for information and approval.

In 2009 the NVR 3.2.1 for control room personnel has been changed with respect to the former 60-years limit of the age of control room staff. Now the qualification is based on performance.

11.2(b) Training and qualification of NPP staff

The Borssele NPP has a training department that is responsible for: maintaining the personnel qualification register, qualification activities, coordination of training activities, training records keeping, and delivering of in-house developed training courses; and organizing training courses that are delivered by contractors. For conduct of the in-house developed training, subject matter experts are extensively used. Training responsibilities for conduct of practical (on-the-job) training are distributed among respective plant departments.

Training and personal development programmes are developed based on competency analysis and consequent training matrix for each job position. Nuclear safety, ALARA principles, industrial safety, operating experience (domestic and international) are included and re-enforced during general employee training, during conduct of initial training programmes and during refresher courses. Training programmes are structured to cover required theoretical knowledge, practical training and on-the-job training. Training material for the basic course is under QA review scheme.

Control room operators, emergency support staff and several others use the full-scope, plant specific training simulator. This simulator was moved from Germany to the site of the NPP in 2024 and the trainers are now employed by the LH.

The contracted staff for running the simulator training programme is of appropriate size and comparable to general industry practice.

External organisations are extensively used for delivering training. For specialised training on specific equipment vendor facilities are used. For safety related subjects, equipment vendors or recognised institutions in the nuclear field are used, for example Westinghouse, Framatome, WANO, and NRG.

Training on emergency preparedness and response is conducted regularly. The plant has a dedicated desktop simulator for emergency exercises, including core melt scenarios for training on SAMGs. Individuals having the position of Site Emergency Director attend position-specific training and once per year a simulator retraining course together with one shift team. Large scale emergency exercises are supported also by training on the full-scope simulator. In relation to the Complementary Safety margin Assessment (CSA) or 'stress test', competence, availability and sufficiency of the staff required for severe accident management has been assessed, including contracted personnel or personnel from other nuclear installations. Several improvements have been introduced. Also training programmes have been improved as a result of among others new insights from the CSA, periodic safety reviews (PSR), operational experience, development of training methods and practices.

Additionally, every year on average five staff members of EPZ are involved in WANO, OSART, and other similar missions. Two EPZ-employees are seconded to the WANO Paris Centre.

Training facilities

The replica full-scope control room simulator is used for training of the Borssele plant personnel. This simulator has been continually updated to reflect the changes in the real plant and control room. The training is given in Dutch. The annual retraining programme for operations control room personnel is developed corresponding to a 5-year training plan. Learning objectives are developed based on competences and operational feedback (communication skills). Additional topics are added based on operations management inputs and feedback from trainees. Operators attend two weeks of on-site training where one part is on plant modification (just before outage) and the second part is on applicable portions of the annual refresher course. Both the training programme and the simulator need to be approved by the RB.

For shift team evaluation the plant developed a method for continuous evaluation based on 20 elements that are documented in each scenario exercise guide; results are followed for recognition of weak areas in performance and used for future attention.

In addition to the full-scope control room simulator the LH also has dedicated rooms for practical training. Various comprehensive mock-ups are available and most of them were developed in-house. Several mock-ups have the capability to introduce malfunctions and are excellent tools for training on troubleshooting techniques. Mock-ups and simulators include: instrument panels, electrical equipment, the fuel-loading machine, a steam generator bottom section, special valve types (disassembly/reassembly) and a loop flow simulator. Furthermore the LH has built a comprehensive environment with technical installations to simulate the working conditions in the radiologically controlled area.

Formal authorisation before assigning certain persons

A formal authorisation issued by the RB or by another body delegated or authorised by the competent authority is required before certain persons are assigned to a designated safety related position.

According to NVR 3.2.1, control room operating personnel need to be in possession of a special licence. This is issued once the candidate has completed a specified period of training and passed an examination which is supervised by the RB. The licences are signed by the plant manager and co-signed by the director of the ANVS. All training, education, examinations and medical checks of licenced personnel are documented.

There are three levels of control room licences that require renewal every two years:

- Reactor operator;
- Senior reactor operator;
- Shift supervisor;
- Deputy shift supervisor.

There is no difference between the qualifications required for operators working on the nuclear side and those working on the turbine side, as the policy is that operators should be fully interchangeable.

Instructions to plant staff on management of accidents beyond the design basis

For the management of accidents beyond the design basis an emergency plan is implemented and agreed with the authorities. Instructions from the emergency procedures are applied. From these are initiated for example the symptom based procedures and the Severe Accident Management Guidelines (both originally from the PWR Owner's Group). In addition the emergency staff in case of an incident can use the software package WINREM which features a reliable model for the dispersion of radioactivity and the calculation of the potential consequences of accident releases.

Assessment method of qualification and training of contractor's personnel

At the Borssele NPP, qualifications of the contractors depends on their job or area they have to work in. Independent to their job or area, all the contractors are qualified for industrial safety by the VCA qualification. This is a general Dutch qualification for working in the industry, like the international equivalent SCC[68]. In addition to that, EPZ has two courses that are compulsory for all workers, whether they work in 'conventional' or 'nuclear' areas and that aid working safely at EPZ's plant. Besides that EPZ has a special qualification for work party leaders called Ziza. All the work party leaders and workers who work without supervision in the plant are specially qualified for this work. Qualifications of special craftsmen are part of the purchasing conditions and are controlled by the purchasing department.

11.2(c) Assessment of sufficiency of staff at the NPP

The process of recruitment and selection of staff is managed so that it ensures enough qualified staff under all circumstances. Performing independent internal audits assesses this process.

With regard to staff sufficiency and the planning of manpower, EPZ continuously monitors the actual staffing and competence levels whereby key performance indicators (KPI) of the level of staffing and competence are reported to the management team. EPZ anticipates on future turnover and retirement by collecting and analysing the plants demographics and HR data. Generated outputs show when recruitment needs to start and at which moment certain competences are needed. In this way EPZ improves their response to labour fluctuation (turnover, replacement, retirement, etc.). When replacements are needed, EPZ first looks to fill positions from within its own organisation. When positions cannot be filled from within the organisation itself, EPZ recruits from the labour market. High standards for new employees are set both in the area of knowledge & experience as well as in behaviour and attitude (towards safety). The recruitment process includes pre-employment screening and the use of assessments and tests/examinations.

For both the long and short term management of staffing levels, two methods are used; succession planning for Key and Non-Key positions.

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[68] Safety Health and the Environment (SHE) Checklist Contractors

For all key positions within EPZ, a specific succession planning is in place. These specific key positions are defined as all crucial roles within the organisation both technically and managerial. In sessions with supervisors, managers and the management team EPZ periodically identifies potential successors for key positions and mitigating actions to ensure effective succession are discussed. The 9 box talent model (Lominger) is used as a basic tool to ensure a structured approach and has an important role in detecting and developing talent for the key positions.

Succession planning for non-key positions is mainly made possible through career paths. Within maintenance and operation in particular there are clear paths for operators and mechanics to promote. For example operators are promoted to reactor-operator and mechanics to technician or even engineer. By identifying talent and offering training and education the majority of positions is filled in by promoting employees from within the organisation.

11.2(d) National supply of and demand for experts in nuclear science and technology

In the Netherlands, education in radiation protection, nuclear safety and nuclear technology is provided by several universities and other organisations. Education in nuclear technology at academic level is provided by the Delft University of Technology. Many companies applying nuclear technology provide in-company trainings.

At the moment there seems a balance between supply and demand. At times it may be difficult to find an expert with a certain number of years of relevant experience. But several companies also get qualified staff from abroad. Trainings can also be contracted abroad like with Framatome in Germany, Westinghouse and Tractebel in Belgium and (for the regulators) with GRS in Germany and SCK-Mol in Belgium.

To be able to meet the increasing demand for experts resulting from the plans to build new nuclear power plants in The Netherlands, the national government launched a dedicated programme in 2024 through which € 65 million will be invested in the nuclear knowledge infrastructure until the year 2030. This program consists of a Human Capital Agenda, and a Knowledge and Innovation Programme.

11.2(e) Supervision of adequacy of human resources at the LH

The surveillance programme of the ANVS includes human resources. The LH's number of staff, their education, their training and their experience are being assessed periodically. Safety relevant changes in organisation and staff must be approved by the ANVS.

11.3 Summary of Significant Changes Since Last Report

- The simulator moved from Essen (Germany) to Borssele in 2024.
- In addition to the full-scope control room simulator the LH also has updated dedicated rooms for practical training.
- Launch in 2024 of a dedicated programme by the national government on nuclear knowledge infrastructure.

Article 12. Human Factors

12. Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

The Kingdom of the Netherlands fulfills the obligations of Article 12.

12.1 Introduction

Human Factors (HF) refer to all factors in the work environment as well as the human and individual characteristics that may have an impact on health and safety at the workplace. HFs can be classified into two categories: internal factors such as talent, competence, professional skills, motivation, stress resistance and situational flexibility; and external factors such as work environment, actual and potential process control, procedures, training and education, accessibility of components and automation. The emphasis in the design of man-machine interfaces is one of the external factors.

Although man-machine interfaces have always played a role in the design and operation of complex machinery such as NPPs and aircraft, it is only in recent decades that they have become part of the evaluation and attention processes and as such are widely recognised. With the development and performance of PSAs, systematic data collection and structural modelling have become part of the process of evaluating Human Factors.

12.2 Legislative aspects of HF

Human Factors play an important role in nuclear safety. The Dutch rules and guidelines (NVRs) referenced in the licence of Borssele NPP – especially those related to the Management System and the operation – do take account of Human Factors, as do the original IAEA Safety Guides the NVRs are based on.

Since the NVRs are part of the licence, the LH is required to give full consideration to Human Factors.

12.3 Methods and programmes for human error

The evaluation method to be used when inspecting and assessing the influence of Human Factors on incidents needs to be based on a well-proven systematic approach. The method being used since 1992 by the Dutch LHs is the original American method known as the HPES (Human Performance Enhancement System).

To improve the results on human performance, the plant has started a Human Performance Programme that covers the following subjects:

- Embed the organisational aspects of Human Performance in daily operations;
- Create, communicate and reinforce Management Expectations, including the use of Human Performance tools;
- Improve effectiveness of management in the field;
- Perform and improve Human Performance initial and refresher training courses;
- Development of a work practice simulator in which Human Factors is fully integrated;
- Improve event analyses with respect to Human Factors;
- Continually improve Human Factors and refresher trainings.

12.4 Self-assessment of managerial and organisational issues

There are assessments of the impact of proposed operational or design changes on safety and the Periodic Safety Reviews (PSRs). These are regulatory and institutionalised requirements. The licence requires two formal types of PSRs, to be reported to the RB: the 2-yearly PSR and the 10-yearly PSR. The documentation of the PSRs is subject to regulatory review. For details on PSRs refer to the chapter on Article 14 'Assessment and Verification of Safety'.

On top of these assessments, the LH regularly performs self-audits, or requests audits or peer reviews by others in order to evaluate its own operation. In particular the organisational, personnel and administrative aspects of operation are subjects for these audits and peer-reviews.

Other examples of self-assessment with consideration of HF are the WANO-Peer Reviews in 2012, 2014 (follow-up), 2016, 2018 (follow-up), 2020, 2022 (follow-up) and 2025. The 2012 SALTO mission had a part dedicated to organisational aspects (relevant to LTO). A pre-SALTO mission was conducted in 2024 with the aim of preparing for a possible second lifetime extension. An OSART mission was conducted in 2014, with follow-ups in 2016 and 2017. A second OSART mission was conducted in 2023, with a follow-up taking place in 2025.

An important aspect in the assessment of safety is the ability of the assessor to make use of the state-of-the-art technologies and methodologies. Therefore, experts of the LH participate in audit and peer-review teams of IAEA and WANO to evaluate other plants. Participation in Technical Support Missions at other plants is encouraged. The insights gained from these participations are used in their assessment work at Borssele NPP.

At Borssele NPP, the internal safety review of technical and organisational modifications is organised as follows:

- *Technical*: All aspects of technical modifications relevant to safety are documented in a 'Modification Plan'. This report is verified by all relevant specialists. After their comments have been taken into account, the report is independently reviewed by staff in the Safety Design Department. Once accepted by this department, the original report and the independent review report are sent to the Internal Reactor Safety Committee to advice the Plant Manager for authorisation. The last step in the review is an assessment under the authority of the ANVS. In the case of minor modifications with no impact on safety, a simplified procedure is applied.
- *Organisational*: Proposals for safety-relevant organisational modifications are prepared under supervision of the Human Resources Management Department and go through a number of review stages. The final proposal is outlined in a report describing the changes relating to the organisation (structure, tasks/responsibilities, systems, documents, staffing and potential associated impact on nuclear safety). The (internal) independent nuclear safety officer checks the final proposal against all the organisational requirements laid down in the licence, NVRs (amended IAEA codes and guides) and other relevant regulatory documents and produces a report on his findings. Also, the risk manager ensures an independent risk assessment. The final proposal is then reviewed by the internal reactor safety committee of the Borssele NPP before being submitted to the authorities.

12.5 Human factors and organisational issues in incident analysis

At the Borssele NPP information on event reports and analysis results and near miss reports is accessible to all staff. The categories 'written procedures' and 'personnel work practices' are causing most human errors. Lessons learned or corrective actions from operating experience are implemented in various ways. For example enhancements of the work instructions, tool box meetings to raise the awareness about the human factors in events, and adjustment of training programmes to focus on trends. For operations personnel, the feedback on operating experience is part of the annual refresher training, which is also attended by other staff. Statistical information derived from the annual report, lessons learned and important external events are on the agenda of that training. Statistical information is also used as input for the business planning and control cycle.

In the Netherlands, LHs address the subject of Human Factors in their annual reports. Good examples are the LHs of the Borssele NPP (LH: EPZ) and the High Flux Reactor in Petten (LH: NRG).

12.6 HF in organisational changes

Several of the LHs in the Netherlands are (or have been) engaged in processes of organisational change, often paralleling changes in their hardware. The reorganisations meant to clarify the responsibilities; to shorten the management lines; to improve cross functional functions (particularly during outage); and anticipate and adjust the resources accordingly. WANO and or IAEA missions are carried out on a regular basis. They review amongst others human factors.

12.7 Fitness for duty

In the Netherlands there are several laws that regulate the protection of the health and safety of employees. Examples are the law on working hours Act ('Arbeidstijdenwet') and a specific law focused on a safe and healthy work environment('Arbo-wet').

Furthermore, the nuclear safety rules require specific medical tests:

- Under NVR 3.2.1, control room operating personnel need to be in possession of a special licence. This is issued once the candidate has completed a specified period of training and passed an examination and medical test. The medical test is repeated every twelve months.
- Under NVR-NS-G-2.7, all site personnel who may be occupationally exposed to radiation at the nuclear power plant shall be subjected to an initial and to periodic medical examinations as appropriate.

In 2009, the management of the Borssele NPP introduced alcohol tests and in 2022 drug tests were introduced.

12.8 Supervision related to HF

Human Factors and organisational issues related to safety have become more important subjects in all types of industries, including the nuclear industry. Organisational issues and Human Factors are assessed by the ANVS in relation to work preparation, composition of teams, work execution, internal communication, leadership for safety, process control, and incident analyses.

Recently, the ANVS has started to pay attention to Human Factors Engineering (HFE) in the construction of new nuclear facilities. The ANVS also closely monitors the organisational changes within the organisation of the LH.

Article 13. Quality Assurance

13. Each Contracting Party shall take the appropriate steps to ensure quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

The Kingdom of the Netherlands fulfills the obligations of Article 13.

13.1 Introduction

The quality assurance programmes originally formally introduced at the nuclear installations in the Netherlands were based on the first IAEA Safety Series on QA. They have since been modified in line with international developments. A description of the initial period, the development of the programmes and cooperation between the parties involved was given in the Netherlands' first and second national reports on compliance with the Convention on Nuclear Safety.

In the nuclear sector, there has been a change of policy in the form of a shift from simply complying with a set of rules towards performance-based Quality Management Systems (QMSs), accompanied by processes of continuous improvement.

The importance of good safety management at nuclear installations is well recognised in the Netherlands. The aim of safety management is to formulate good safety policies for the relevant installation and this includes ensuring that the reasons, effects and consequences of those policies are communicated to all staff.

13.2 Legislative aspects of quality assurance

The transposition of the amended European Nuclear Safety Directive resulted in a new Ministerial Regulation on the safety of nuclear installations dated 14 June 2017 (MR-NV). In its Article 9, it lists requirements to the management system of the LH. Furthermore there are rules and guidelines on quality assurance for LHs of NPPs in the Netherlands in a Ministerial Regulation which refers to the requirements and safety guides in the IAEA Safety Series (50-C/SG-Q), amended, where necessary, for specific use in the Netherlands. Separate from this, since 2011 relevant and updated NVRs are attached to the licence of the NPP, like NVR-GS-R-3, NVR-GS-G-3.1 and 3.5. In addition the WENRA Reference Levels apply.

In the NPP licence, a requirement is to comply with the Safety Requirements for nuclear power plant operation, NVR NS-R-2 (Safety of NPPs: Operation). This document requires that the operating organisation must be aware of the special emphasis that needs to be placed on safety when operating nuclear power plants. This special emphasis and commitment to safety must be reflected in the organisational structure.

NVR-NS-R-2 also states that plant management has a direct responsibility for the safe operation of the plant. All safety-relevant management functions, such as decisions on financial, material and manpower resources and operating functions, must be performed and supported at the most senior level of management.

NVR GS-R-3 'The Management System for Facilities and Activities' requires any LH to establish a management system where priority to safety is paramount, including assuring a sound safety culture. The requirements in this NVR apply to all nuclear facilities.

Although the General Safety Requirements, No. GSR Part 2 (2016) "Leadership and Management for Safety" is not included in all licences, this IAEA requirement is used by all LHs to provide leadership for safety within their organisations.

The ANVS verifies the management systems of the LHs during the regular inspections.

13.3 Integrated management system (IMS) at the Licence Holder

The management system at the LH of the NPP has been in place more than 20 years. The system has been renewed and is in compliance with the international requirements (GS-R-3) and guidelines.

Over the last few years, the policies and elements of the revised IAEA guidance have been introduced in close consultation and cooperation with the management of this plant. The IMS has been renewed a number of times to integrate the different aspects relevant to safe and reliable operation – such as safety culture and leadership, continuous learning and human factors- and with the objective to comply with new international requirements (such as GSR part 2) and guidelines.

The LH has also made a transition towards performance-based quality assurance. This has required a modification of the plant's written processes and instructions, together with a change in attitude on the part of management and staff. The use of performance indicators has led to a process control based on more quantitative criteria.

Although more attention is paid to knowledge management, attention still needs to be paid to the minimum staffing level for the various sections of a LH's organisation and to the subject of subcontractors. The implementation of the EU-directive on nuclear safety version 2014 introduced requirements also for the contractors.

13.4 Supervision related to quality assurance

The inspections by the ANVS are also covering the (quality) management systems of the LHs. Most of the nuclear installations in the Netherland are of a relatively high age. Due to this fact, more attention has to be given to subjects as ageing and the assessment of the effectiveness of maintenance programs in use, in addition to the IMS approach.

Article 14. Assessment and Verification of Safety

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

(i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the Regulatory Body;

(ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

The Kingdom of the Netherlands fulfills the obligations of Article 14.

14.1 Comprehensive and systematic assessment of safety

14.1(a) Licensing and regulatory requirements

In the Netherlands, a licence is needed for the construction, operation, significant modification or decommissioning of a nuclear installation. The ANVS grants all licences for nuclear facilities based on the Nuclear Energy Act and subordinate regulation. For a comprehensive description of the applicable regulatory framework, refer to the text on Article 7 in the present report.

In the licensing process, the ANVS applies a number of guiding principles. The approach used by the ANVS is described in a document entitled “Guidance Licencing ANVS” (Handreiking Vergunningverlening ANVS). This document, which was first published in 2017 and was updated in 2025, also gives a general description of the way in which facilities are terminated and decommissioned. The document has been published on the ANVS website and therefore is available to LHs and the general public. It aids the LHs in properly conducting their role in the licensing process. In addition there are guidance documents on various specific topics.

It should be noted that also probabilistic safety criteria apply, laid down in the Bkse Decree (refer to text in Article 7). The latter also includes dose-frequency constraints within the design-basis envelope. Appendix 1 gives a detailed overview of the probabilistic safety criteria.

The applicant shall demonstrate that he satisfies all regulatory requirements under the Nuclear Energy Act. If a certain requirement cannot be met, the applicant shall demonstrate to the satisfaction of the ANVS that he will achieve the safety objectives of the Act in another way.

Applicable technical safety guidelines

NVRs on Design, Operation et cetera are attached to the licence of Borssele NPP and represent licence conditions.

However, the NVRs are fairly general and do not provide the technical detail found in national codes and standards of some other countries (e.g. KTA). Since 2015 there is the VOBK, the Guidelines on the Safe Design and Operation of Nuclear Reactors - Safety Guidelines for short. This document is currently being revised. These Guidelines provide new reactor licence applicants with detailed insight into what the ANVS considers to be the best available technology. This document elaborates on regulations in the Nuclear Energy Act, the Nuclear Facilities, Fissionable Materials and Ores Decree and the Ministerial

Regulation on Nuclear Safety for Nuclear Installations. Apart from this document, there are no nationally developed nuclear codes and standards in the Netherlands.

Therefore, additional material is needed to define the licensing basis and the applicant will propose a suitable set to the satisfaction of the ANVS. This can include parts of e.g. the US Code of Federal Regulations, the US NRC Regulatory Guides, the US NRC Standard Review Plan, the ASME code, the ANS/ANSI standards, KTA standards, and RSK recommendations. These documents have no formal status in the Netherlands. The NVRs require the applicant to specify and defend the technical basis and industry standards he is going to use. In this process, the ANVS expects the applicant to demonstrate that:

- The chosen set of foreign regulations and industry standards are consistent with the relevant NVRs;
- If more than one set of standards or regulations is to be applied, the various sets should be consistent.

Safety Report, Safety Analysis Report and PSA

To support his licence application, the LH shall draft (among others) a Safety report (SR) and a Safety Analysis report (SAR), which it shall submit to the ANVS together with the application. The SR is the report that is attached to the licence, and as such it is a public document. It describes the organisation, the design, the outcomes of the safety analyses, et cetera into some detail. The SAR gives a more detailed description of the proposed facility and presents an in-depth analysis of the way in which it complies with the NVRs and other applicable regulations. Its claims are supported by detailed descriptions of the safety analyses, simplified system diagrams, and other supporting documents. To illustrate the difference between SR and SAR: the Borssele NPP SR is a one-volume document, whereas the associated SAR is a twenty-volume document. Both documents are updated with each modification of the installation, if there is a licence application needed.

The SAR is supported by a Probabilistic Safety Analysis (PSA), comprising levels 1, 2 and 3 (see Appendix 2). The PSA – in particular the level-3 part of it – is needed to demonstrate that the facility meets the probabilistic safety criteria as laid down in the regulations (Bkse Decree, see section on Article 7).

14.1(b) Review of safety cases by the Regulatory Body

In case of a licence application, the ANVS studies the SR in depth. The underlying and supporting documents are also reviewed in depth to ensure that the regulations have been met. In the review process, selected items are analysed with computer codes other than have been used for the original analyses provided by the LH. Often, assessments of similar power plants performed by a foreign Regulatory Body are also considered. The ANVS often seeks the help of Technical Support Organisations (TSOs).

The ANVS has asked the IAEA to provide support to ensure the proper assessment and review of PSA results. The IAEA has undertaken peer reviews of the PSAs (the IPSART missions) and has given training courses in PSA techniques and PSA review techniques. Appendix 2 provides further information both on the role of the PSA in relation to safety assessment and on the associated regulatory review.

Once the reviews and regulatory assessments have been completed and it has been established that the applicant is acting in accordance with the rules, regulations and radiological safety objectives, the licence can be granted. The assessments are documented, as required by the ANVS' internal QA process.

14.1(c) Periodic Safety Reviews (PSRs)

One of the licence conditions of the Borssele NPP is that the safety of the nuclear installation is periodically reviewed in the light of operating experience and new safety insights. In addition, the EU-directive on nuclear safety is applicable since 2011 and was reinforced with the 2014 Amendment. This EU-directive contains a similar requirement. For RRs, the same requirement applies.

The licence of the NPP requires a review of operational safety aspects to be performed once every two years, whilst a more comprehensive safety review must be conducted once every 10 years. The latter involves a review of the plant's design basis in the light of new developments in regulations, research, safety thinking, risk acceptance, etc.

After the first 10 years of operation modifications were made to the NPP related to major evaluations after the TMI-incident. The major evaluations were no formal PSR. Some bunkered systems were added containing back-up cooling systems. The policy on backfitting was first formulated in 1989.

After that at the Borssele NPP, there have been three 10-yearly PSRs, called '10EVA': in 1993, 2003 and 2013. The fourth PSR was completed in 2023 and the LH is currently in the process of implementing the improvements highlighted in this review. These are further described in Appendix 4.

Each PSR has been followed up with an evaluation and a decision about measures to be implemented, and subsequently a modification project. Throughout the years, the focus has moved from hardware-oriented modifications to more organisational or procedural modifications.

- The first PSR (1993) was followed by a major 200 million euro modification programme, with increase of functional and structural separation, protection against external events and so on.
- The second PSR (2003) resulted in a fine-tuning of the safety concept of the plant rather than major changes.
- In compliance with the licence the LH issued a third 10-yearly safety review at the end of 2013 (10EVA13). There was some interface with LTO-issues, but it was agreed by the ANVS and EPZ not to combine the two subjects of LTO and PSR but to execute two complementary projects, each having its own time frame. For the LTO-project, refer to section 14.1.d.
- All identified safety-enhancing measures from 10EVA13 have been completed. There were 19 technical measures and four more organisational, personnel and administrative measures. This PSR also had some interfaces with the CSA.

In Appendix 4, a detailed description is given of the modifications of the Borssele NPP resulting from the various 10-yearly PSRs, including the last PSR in 2023.

14.1(d) Long Term Operation

The Safety Report of 1993 (VR93) contained a statement that the design of the plant is based on an operating period of 40 years starting from 1973. Therefore the LH had to apply for a licence approving Long Term Operation (LTO). This had to be supported by sound evidence that the plant can be safely operated for a longer period. It was agreed by the RB and EPZ not to combine the two subjects of LTO and PSR but to execute two complementary projects, each having its own time frame. The LTO project resulted in a licence application that was submitted for regulatory review in 2012, the licence was granted in 2013. The LTO project was carried out using IAEA Safety Report Series 57, complemented with two safety factors: SF10 Organisation, Management System and Safety Culture and SF12 Human Factors from the IAEA guidance on PSR.

The LTO process was supported by a limited scope IAEA SALTO mission in 2009, with the aim to see if the LTO-programme and approach was comprehensive and according to the state-of-the-art. At the end of the LTO programme and in the phase of the licensing a full-scope SALTO mission was carried out in May 2012, covering also the follow-up on the mission in 2009. The final LTO-licence was given in March 2013, including the provision to complete the measures based on the SALTO mission recommendations before the end of 2013. In February 2014 the final follow-up SALTO mission was carried out.

In the final LTO-licence, a set of specific LTO requirements (with end dates) was incorporated related to ageing management. Except the final verification for the RPV integrity based on an assessment of the surveillance specimens, all the requirements are fulfilled. The verification for the RPV was finished in 2019. The results have been published in paragraph 2.4 of the 2019 Netherlands National Action Plan Topical Peer Review Ageing Management. Based on the ageing management review which was part of the LTO project a living ageing management process was introduced. The LH will continue this process including updating the ageing management based on internal and external experiences.

Currently Borssele NPP is investigating the possibility for a second LTO for operation beyond 60 years. In 2024 a pre-SALTO was performed to prepare for a SALTO mission in the coming years.

Topical Peer Reviews

In 2017 all EU Member States and some neighbouring states carried out a National Assessment of Ageing Management Programmes (AMPs) of nuclear installations (NPPs and RR > 1 MW) under the auspices of ENSREG. The assessments were conducted according to the WENRA Topical Peer Review Specifications. In the Netherlands, Borssele NPP and the two research reactors participated, in fact conducting a self-assessment, independently reviewed by the ANVS, published in 2017. In 2018 there was a peer review, including a workshop, organised by ENSREG. In October 2018 ENSREG published a general report and a report with country-specific findings. In 2019 the National Action Plan was published and it was updated in 2021 and 2023. As mentioned previously in this report, two actions related to the improvement of licences for HOR are expected to be completed by 2026.

Topical Peer Review II: Fire Protection

The Netherlands is involved in the second Topical Peer Review since 2022, in the topic of Fire Protection of nuclear installations, under the auspice of ENSREG. All the nuclear installations in The Netherlands are covered (Borssele NPP, RR HFR, RR HOR, Urenco Nl and COVRA). The National Assessment Report (NAR) was developed and coordinated by the ANVS in close collaboration with the licencees, and was published in October 2023. This report was afterwards reviewed by experts from ENSREG, with public involvement. During 2024, a round of Questions and Answers based on the NAR was carried out, together with a site visit to the HOR research reactor in Delft. The results, findings, good practices and areas of improvement were presented and discussed in two workshops. The Thematic Workshop was focused in the different type of installations and technical topics, and the Country Workshop was focused on the findings per country. A National Action Plan will be drafted and implemented in 2025-2026, considering the findings from the NAR, the workshops and the review from the experts.

14.1(e) Safety assessments related to modifications

Significant changes to the installations that imply changes to the design assumptions, as laid down in the Safety Report, require a licence change. New safety analyses have to be performed to demonstrate that the safety impact of these modifications remain within the prescribed limits. An example of a change requiring a safety analysis is the following.

In the late nineties the safety report and some safety analyses were updated when the LH of the Borssele plant submitted a request for a modification of the licence in order to be able to use higher enriched fuel elements (from 3.3% up to 4%). External experts were consulted for the review. There was special emphasis on issues associated with high burn-up fuel in relation with prevention of reactivity insertion accidents (RIA-accidents). The review was repeated at the end of 2003. A modification of the licence was requested to use 4.4% enriched fuel and a burn-up limit for fuel rods averaging 68 MW day/kg U by using the new Niobium-Zirconium cladding material M5 (Framatome) with an improved corrosion behaviour. Up to now the average burn-up of the fuel never exceeded 60 MW day/kg U due to the constraints (heat, radiation) imposed by the specifications of the spent fuel containers. The power plant has provided additional tests of the fuel quality before going from 60 to 68 MW day/kg U for the whole core.

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.

In 2015 a licence was granted for the main modifications from 10EVA13 combined with a complete revision of the operating licence which has been implemented by 2017. In 2023 10EVA23 was finished with a conceptual review report by the Borssele NPP. Several improvements were identified. However this PSR was performed without operation beyond 60 years in its scope. Currently preparations are made to identify reasonable safety improvements taking into account this longer period of operation.

14.1(f) Safety assessments initiated by the LH or the RB including audits and peer review missions

Apart from the assessments of the impact of proposed operational or design changes on safety or the periodic safety reviews, which are both regulatory and institutionalised requirements, the LH regularly performs self-audits, or requests audits or peer reviews by others in order to evaluate its own operation. Examples of this practice are the WANO Peer Reviews. The WANO peer review frequency has been increased to once every four years after the Fukushima Daiichi accident.

Also the regulator may request a peer review. In particular the organisational, personnel and administrative aspects of operation are subjects for most of these audits and peer reviews. At least every 10 years there will be an OSART mission at the NPP. OSART missions took place in 2014 (with follow-ups in 2016 and 2017) and 2023. WANO peer reviews in 2020 and 2025.

14.1(g) Supervision by the RB of compliance with licence conditions

After a licence has entered into force the ANVS assesses the implementation. This means in practice that the LH is required to send detailed documentation about safety relevant modifications which will then be reviewed before final implementation. During implementation inspections are carried out. The ANVS supervises for instance the implementation of the stress test measures, the MOX licence, the LTO-licence and the improvements from the PSR. The ANVS often seeks the help of a Technical Support Organisation (TSO).

For more details about supervision and enforcement, refer to the text on Article 7.

14.2 Verification by analysis, surveillance, testing and inspection

In general, the LH is responsible for inspecting and testing all NPP equipment and systems in order to guarantee their safe operation.

EPZ has performed an LTO assessment to justify safe operation with Borssele NPP until 2034. In this LTO assessment a specific verification of the existing 5 plant programmes (maintenance, surveillance, in-service inspection, chemistry and equipment qualification) was performed. It could be shown that the 9 attributes according to IAEA Safety Report 57 are adequately fulfilled in the programmes.

The regulatory authority checks that the inspection and test programme of the LH is adequate for this purpose.

The relevant NVRs are NVR-NS-G-2.6 (Maintenance, Surveillance and Inspection) and NVR-NS-G-2.1 for fire protection. In addition, the licence requires that the Borssele NPP has an ageing management system for all structures and components important to safety, so as to enable plant management to take appropriate action in time. A specific department at the Borssele NPP reviews information on ageing of structures and components. This includes internal information (maintenance, in-service inspection etc.) and external information (event reports on ageing, direct information from other plants etc.). This ageing experience feedback programme operates in addition to the existing programmes involved in ageing management (in-service inspection, maintenance, chemistry monitoring etc.).

Based on the results of a comprehensive Ageing Management Review performed in the LTO assessment, EPZ has further improved the existing ageing management process by introducing a specific procedure on ageing management of passive structures and components important to nuclear safety in the plant. This procedure is owned by the aforementioned department and is particularly important to improve coordination and traceability of ageing management activities. NVR-NS-G-2.12 is the basis for this procedure. Using this procedure, recommendations from the LTO Ageing Management Review were implemented.

Experts of the LH involved in LTO and ageing management are involved as experts and reviewers for IAEA SALTO Peer Reviews. The LH and the ANVS are also involved in the IAEA I-GALL programme which is an important platform to share international experiences with ageing issues and ageing management programmes.

The oversight of in-service inspections (non-destructive examinations) of nuclear pressure retaining equipment is according to the Dutch rules every two years designated from the ANVS to an independent and certified organisation. The in-service inspection programme is based on ASME XI and has in line with ASME XI a ten-year interval. Before the new interval the LH applies for the programme of the new interval. The programme is authorised by the ANVS and the independent and certified organisation will perform the oversight based on this programme.

The ANVS conducts regular inspections and audits to check the other inspection and test activities at the power plant. All additional reviews and inspections carried out in response to the demonstration of

hydrogen flakes in the Belgian Doel/Tihange plants did not reveal such hydrogen flakes in the Borssele NPP.

The current licence of the Borssele NPP includes a requirement for a Living PSA (LPSA). The reason for this is that the ANVS recognises an LPSA as being a suitable and sufficiently mature instrument of analysis to support certain aspects of safety-related decision-making in matters of design or procedures. These LPSA applications can reveal the effects of apparently insignificant changes in design or operating procedure. The requirement in the licence is qualitative. It means that the PSA must reflect the latest configuration of the plant as described in the Safety Report and that the PSA must be used by plant staff when making safety-related decisions. In that respect, the NPP uses a risk monitor, e.g. for configuration control during outages.

An important aspect in the assessment of safety is the ability of the assessor to make use of the state-of-the-art. Therefore, experts of the LH participate in audit and peer-review teams of IAEA and WANO to evaluate other plants. The insights gained from these participations are used in their assessment work at Borssele NPP.

At Borssele NPP, the internal safety review of technical and organisational modifications is organised as follows:

- *Technical*: All aspects of technical modifications relevant to safety are documented in a 'Modification Plan'. This report is verified by all relevant specialists. After their comments have been taken into account, the report is independently reviewed by staff in the Safety Design Department. Once accepted by this department, the original report and the independent review report are sent to the Internal Reactor Safety Committee to advice the Plant Manager for authorisation. The last step in the review is an assessment under the authority of the RB. In the case of minor modifications likely to have no impact on safety, a simplified procedure is applied.
- *Organisational*: Proposals for organisational modifications are prepared by the Human Resources Management Department. The final proposal is outlined in a report describing the changes relating to the organisation (structure, tasks/responsibilities, systems, documents, staffing and potential associated impact on nuclear safety). The (internal) independent nuclear safety officer checks the final proposal against all the organisational requirements laid down in the licence, NVRs (amended IAEA codes and guides) and other relevant regulatory documents and produces a report on his findings. The two reports (the final proposal and the independent verification) are then reviewed by the internal reactor safety committee of the Borssele NPP before being submitted to the authorities.

Article 15. Radiation Protection

15. Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

The Kingdom of the Netherlands fulfills the obligations of Article 15.

15.1 Radiation protection for workers

Current legislation

As stated in the section on Article 7, the basic legislation on nuclear activities in the Netherlands is the Nuclear Energy Act. A number of Decrees have also been issued, containing more detailed regulations based on the provisions of the Act. The most important Decrees in relation to the safety aspects of nuclear installations and the radiological protection of workers and the public are:

- The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse); and
- The Decree on Basic Safety Standards Radiation Protection (Bbs).

These Decrees are fully in compliance with Council Directive 2013/59/EURATOM laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation.

Bkse requires the Licence Holder (LH) of every nuclear power plant to take adequate measures for the protection of people, animals, plants and property. Article 31 of Bkse states that a licence must contain requirements aimed at as far as possible preventing the exposure and contamination of people, animals, plants and property. If exposure or contamination is unavoidable, the level must be as low as is reasonably achievable.

Bkse also states that these activities must be carried out by or under the responsibility of a person judged by the Regulatory Body (RB) to possess sufficient expertise. This expert must occupy a post in the organisation such that he or she is able to advise the management of the NPP in an adequate way and to intervene directly if he or she considers this to be necessary.

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

In conformity with the EURATOM basic safety standards, the Bbs stipulates a limit of 20 mSv per annum as the maximum individual effective dose for radiological workers. In practice, no cases have been recorded which exceeded the 20 mSv per annum standard. If a problem should occur, there is an article in the Bbs that permits a higher dose in exceptional situations subject to stringent conditions. To date, the nuclear installations in the Netherlands have never experienced such a situation.

Implementation by the Licence Holder of Borssele NPP, EPZ

The LH has set a dose constraint of 6 mSv per annum as the objective for the individual effective dose limit for radiological workers at the Borssele NPP and aims to keep the dose below 3 mSv per year. If this target is exceeded the dose should not be higher than 15 mSv in 5 years.

The average effective individual dose for both in-house personnel and externally hired personnel at the Borssele plant has shown a decreasing trend since 1983. The trend in the collective dose has been very similar to that of the individual doses. In the early eighties, the total collective dose amounted to 4

personSv per annum. Over the two decades it decreased to about 0.4 to 0.6 personSv per annum depending on the amount and type of work performed during outages.

Since 2009 the collective dose is rising due to the many extra activities and monitoring that are needed due to the LTO programme. Executing the LTO Programme is essential to keep satisfying the requirements imposed by the RB on the ageing NPP. In 2010 the total collective dose was about 0.6 personSv. In 2011 and 2012 the collective dose was about 0.3 personSv, 2013 showed a peak related to LTO activities, after which the dose dropped substantially. In 2016 and 2017 the collective dose increased to about 0.6 personSv per annum due to extensive steam generator works. In 2018 the collective dose decreased to about 0.4 personSv per annum comparable with 2012. The collective dose was significantly lower in 2019 (0.25 personSv) and 2020 (0.1 personSv), partly because of the COVID-19 pandemic. In 2021 it was back at the level of former years with 0.45 personSv. This rise was mainly caused by extra maintenance and inspection works related to the jobs which were not done in 2020. With 0.29 personSv in 2022 and 0.27 personSv in 2023, the collective dose was again at the low levels of the last decade. In 2024 the LH executed a great deal of planned maintenance activities which resulted in a collective dose of 0.6 personSv. These activities included in-service inspections and repair work in proximity to the primary system and this contributed to the higher collective dose.

One of the conditions of the licence issued to the Borssele NPP is that the expert responsible for radiation protection should be adequately qualified (as radiation protection expert) and is also required to hold a sufficiently independent position in the organisation to allow him to advise the plant or site manager directly on all matters of radiation protection. A description of the requirements for this expert's qualifications, as well as the qualifications which a number of other radiation protection officers need to possess, is given in the Technical Specifications (TS). The appropriate training programme covers the qualifications of the other officers.

Classification of radiation workers and personal dosimetry records - general

An employer of a facility where workers can be exposed to ionising radiation is required to classify persons as radiation workers in one of the categories A or B for individual monitoring and supervision purposes. Category A workers are likely to receive doses greater than three-tenths of the dose limit for workers (6 mSv per year for whole body exposure). The employer shall ensure these workers are subject to medical surveillance and an individual monitoring programme arranged in accordance with requirements of the Bbs. Category B workers are likely to be exposed during their work to radiation greater than the dose limit for members of the public (1 mSv per year for whole body exposure), but less than 6 mSv per year. The employer of a category B worker shall ensure that these workers are covered in an individual monitoring programme.

Like explained above, an employer, like the operator of a NPP or RR, needs to record doses incurred by each exposed worker using personal dosimetry. Regarding personal dosimetry, no distinction is made between Category A and category B workers. Only dosimetry services approved by the Ministry of Social Affairs and Employment (SZW) 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 SZW. The main objectives of NDRIS are to preserve dosimetric data for the period required by the EURATOM Basic Safety Standards and to bring together all data from all registered radiation workers, including those of foreign workers whose data are identified through the radiation passport.

NDRIS is managed by NRG's business unit Consultancy & Services. In the beginning only data from individuals employed at institutes which had subscribed to the dosimetric services of NRG (and its predecessors) were collected but gradually also data from other approved dosimetric services were added. 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 has been 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 optimise operational radiation protection.

Classification of radiation workers and reporting worker doses at Borssele NPP

Radiation workers at Borssele NPP are classified as A-workers: the occupational exposure is limited to 20 mSv (effective dose) per annum effective dose. All workers use two dosimeters: an EPD and a TLD. The EPD issued by the LH can be read directly and is for direct use. The TLD is used with an integration period of one month; after annealing and further processing the total dose during the period is reported to the LH. The records on the personal dosimetry are retained during the period of their working life involving exposure to ionising radiation and afterwards until they have or would have attained the age of 75 years, but in any case not less than 30 years after termination of the work involving exposure.

The current licence of Borssele NPP requires that the LH monitors, quantifies and registers all relevant radiological data. It also specifies the situations in which (and the terms on which) it must inform the RB. Another example of a 'radiation protection'-related requirement in the licence is the LH's obligation to monitor and record the radiation levels and levels of contamination at those locations where workers may receive an effective dose of 5 microSv or more in less than one hour.

Workers who work in places where there is a risk of internal contamination must be checked for this at least once a year. The results must be documented and kept for inspection purposes.

The LH is required to report to the RB every three months the individual doses received by workers who work at locations where they are exposed to an effective dose of at least 5 microSv in less than one hour. If a worker has received an effective dose exceeding 15 mSv within a period of three months, the LH must investigate all the circumstances that could have caused this dose level and must inform the RB of the results. These results have to be reported to NDRIS and are being kept in that system for at least 30 years.

The licence also requires the Borssele NPP to comply with the amended IAEA codes and Safety Guides (i.e. the NVRs). In the domain of radiation protection, Safety Guide NVR-NS-G-2.7 complements the requirements set by the Bbs, and lays down more specific requirements for:

- The lay-out of the controlled zones;
- The facilities within the controlled zones;
- Staff qualifications and training; and
- The radiation protection programmes.

In order to comply with all the radiological conditions, the LH must have adopted adequate procedures for the implementation of such a radiation protection programme. The RB inspects the site to check the effectiveness of these procedures.

Prior to any reactor outage, the LH must give the RB an estimate of the anticipated collective dose. Once the outage activities have been completed, the LH must produce a dose evaluation report and inform the RB of the results.

If the anticipated collective dose relating to any job exceeds 5 man-mSv or the maximum individual effective dose is greater than 3 mSv, the RB will request the LH to produce an ALARA report showing that it has indeed taken the best possible radiation protection measures. The ICRP-60 publication is used as a guideline for this optimisation process. The criteria or considerations for submission of ALARA reports are based largely on a qualitative judgement rather than a quantitative assessment. The choice of the 5 person-mSv limit is pragmatic and is motivated by the legal difficulties concerning the definition of a specific job and the dose history associated with previous jobs.

15.2 Radiation protection for the public

Regulatory requirements

The annual dose limit for public exposure is a cumulative limit that relates to the sum of the annual public exposure resulting from all practices. Since one undertaking cannot be held responsible for the contributions to public dose resulting from practices performed by other undertakings, national policy is that a maximum of one-tenth part of the cumulative dose limit is assigned to the undertaking applying for authorisation of a practice. As a result, the authorised undertaking is obliged to ensure that the effective dose of a member of the public does not exceed the value included in the licence or registration. An application for authorisation will always be refused if the practice results in an effective public dose higher than 0.1 mSv per year.

Situation at Borssele NPP

The licence of the Borssele NPP requires the LH to comply with the amended IAEA Safety Guides (i.e. the NVRs). The Safety Guide NVR NS-G-2.7 'Radiation Protection and Radioactive Waste Management in the Operation of NPPs' complements the requirements set by the Bbs. More specific requirements are laid down in the Technical Specifications of the NPP. Also refer to Appendix 4, 'Technical Details of Borssele NPP'.

The monitoring of all discharges in air and water at Borssele NPP has to comply with the German regulations 'Sicherheitstechnische Regel des Kerntechnischer Ausschuss (KTA) 1503 and 1504'. The actual releases are, with the exception of tritium and carbon-14, normally less than 1% of the discharge limits (Appendix 4).

The design of the installation is the first step towards achieving the radiological safety objectives. The Safety Report (SR) must demonstrate that the design of the plant and planned operational conditions and procedures comply with these objectives. In addition, the radiation dose received by members of the public due to the operation of the NPP, including the discharges of radioactivity in water and air, must be controlled and optimised (ALARA) whenever the plant is in an operational state.

Both the LH (Borssele) and an independent institute, the National Institute for Public Health and the Environment (RIVM) monitor the radiation levels at the border of the site continuously.

As prescribed in the licence, all discharges of radioactive effluents must be monitored, quantified and documented. The LH must report the relevant data on discharges and radiological exposure to the RB. On behalf of the government, the RIVM regularly checks the measurements of the quantities and composition of discharges.

The LH is also required to set up and maintain an adequate off-site monitoring programme. This programme normally includes measurements of radiological exposures (with Geiger-Müller dose rate meters), possible contamination of grass and soil, airborne radioactivity and radioactivity in the marine environment in the vicinity of the installation. The results are reported to – and regularly checked by – the Regulatory Body. Under Article 36 of the EURATOM Treaty, each year, the discharge data must be submitted to the European Commission. The discharge data are also reported to OSPAR, the Convention for Protection of the Marine Environment in the North-East Atlantic.

Non-radioactive materials and wastes are closely examined before release from the site, based on the rules in Bbs and in the licence. Radioactive waste is handled in accordance with Bbs (and lower-level regulation) and the licence. The radioactive waste is sent to COVRA. The LH keeps records of the handled wastes and these will be regularly checked by the RB.

The framework for off-site nuclear and radiological emergency response, is described in the text under Article 16.

Article 16. Emergency Preparedness

16.1 Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the Regulatory Body.

16.2 Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

The Kingdom of the Netherlands fulfills the obligations of Article 16.

16.1 Emergency plans

In this section, on-site and off-site arrangements are discussed in separate sections. The information about on-site issues is focused on the Borssele NPP.

16.1(a) On-site: Severe Accident Management (SAM)

16.1.a.1 Regulatory requirements and licence conditions

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 Ministerial Ordinance on Nuclear Safety (MR-NV). 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 Radiation Protection (Bbs). The Dutch Safety Region Act details the responsibilities for emergency situations in general.

The Bbs requires that LHs make arrangements in preparing for interventions in case of a radiological emergency on-site. The LH has to prepare an emergency plan for each location, which has to be tested frequently. This general requirement is applicable for nuclear installations and sources. Due to the small scale but diverse nature of the nuclear industry in the Netherlands, the details of such obligations of the LHs are not regulated by law, but in the individual licences.

In principle, the approach adopted in the Netherlands enables regulation in accordance with current international practice, and to be flexible in adopting further requirements if this changes. The Dutch legal framework gives the RB adequate powers to require any Severe Accident Management (SAM) measures it deems necessary, the main instrument being through the operating licence.

Conditions at Borssele NPP

Examples of regulatory documents attached to the licence of the Borssele NPP, highly relevant for on-site emergency preparedness, are:

- NVR NS-G-2.15 'Severe Accident Management Programmes for NPPs'.
- NVR GS-G-2.1 'Arrangement for Preparedness and Response for a Nuclear or Radiological Emergency'.

- NVR GS-R2 ‘Preparedness and for a Nuclear or Radiological Emergency’.

Future changes to these NVRs will reflect developments at the IAEA.

The licence of the Borssele NPP contains licence conditions that require the LH to establish and maintain an emergency plan and an emergency organisation, and also to ensure that exercises are conducted regularly, and if needed lead to improvements. The on-site emergency plan and emergency organisation must be consistent with the off-site emergency planning. Furthermore the (public) Safety Report (SR) of the NPP describes the Severe Accident Management Guidelines (SAMGs), Emergency Operating Procedures (EOPs), function recovery procedures (FRPs), and emergency response organisation and how these are interrelated. The SR is an integral part of the licence. Details and substantiation of this information can be found in the underlying documentation, that is not public, but that is subject to evaluation by the ANVS.

Other nuclear installations also have licence conditions requiring to have emergency procedures and arrangements, details of which can be found in their SRs and underlying documentation.

Verification of implementation by the ANVS

The initial site-emergency plans and their adjustments are reviewed by the ANVS and coordinated with the emergency plan of the Safety Region.

The practical implementation of the plan by the LH is subject to periodic safety review (every 10 years) and supervision by the ANVS. Furthermore the LH will have to participate in emergency preparedness and response (EP&R) exercises organised by the authorities. These exercises are evaluated by LH and the ANVS.

16.1.a.2 SAM strategy at Borssele NPP

The Borssele NPP has developed a comprehensive set of procedures to enable it to respond to anticipated operational occurrences (AOCs) and accidents. Simpler malfunctions are the subject of event-based instructions and procedures. Emergency situations are dealt with by symptom-based Emergency Operating Procedures (EOPs). Severe Accident Management Guidelines (SAMG) are intended to provide guidance on accidents involving core damage and potential radioactive discharges into the environment.

In addition, Borssele NPP has developed Flex Support Guidelines (FSGs). These guidelines will provide pre-planned strategies for accomplishing specific tasks during emergency situations to improve the capability to cope with beyond-design-basis external events. It consist of both an on-site component using plant equipment as well as equipment stored at or near the plant site and an off-site component for the provision of additional materials and equipment for longer-term response.

16.1.a.3 Communication of the LH with the RB in emergency situations

If an emergency occurs, the plant management must inform the relevant authorities immediately, advise them of the classification of the accident, and provide all available information that is required in order to assist the ANVS to assess the nature and potential consequences of the accident, to determine the potential for mitigating its effects and to make a prognosis of potential radioactive discharges. Real-time data and process information is available to the ANVS. This is part of the plant information supplied to the ANVS during an emergency. The ANVS has a strict 24/7 schedule to secure its availability during any actual or potential accident or serious incident.

16.1.a.4 SAM facilities at the NPP

Borssele has standard arrangements for controlling the plant in the event of a severe accident. The Main Control Room (MCR) has a filtered air supply and, following a Station Black Out (SBO) event, compressed air and respirators are available. There also is an alternative Emergency Control Room (ECR), which is bunkered, for managing a controlled shutdown, core cooling and spent fuel pool cooling. Both the MCR and ECR have suitable and robust access to plant measurements needed to mitigate consequences of a severe accident.

There are seven operations shift teams at Borssele, each managed by a shift supervisor and each composed of at least eight operators. It is the shift supervisor's responsibility to decide on the extent of the LH's Emergency Response Organisation (ERO) that needs to be activated. Once the ERO is operational, the site emergency director takes over command. Based on data from exercises, the ERO will be set up within 45 minutes (also outside normal working hours) and then requires a further 30 minutes to become operational.

The ERO is a scalable organisation: the number of staff called in (by pagers, phone calls) will depend upon the scale of the emergency being addressed. The ERO will be located in the plant's Alarm Coordination Centre (ACC). This is a purpose-built facility designed for internal events and emergencies. Although it is bunkered (like the ECR), it is not designed to withstand severe external events such as a major flood or an aircraft crash. If the bunkered Alarm Coordination Centre is not accessible, a backup location is provided in Middelburg at the head office of the Safety Region.

16.1.a.5 Evaluation of SAM capability and (potential) safety improvements

In the European ENSREG-led Complementary Safety margin Assessment or 'stress test', EPZ has evaluated its SAM capability and has judged it adequate, although noting several options for improving on this capability. The ANVS has reviewed the findings which resulted in refinement of the list of actions. Examples of notable improvements are discussed below.

When EPZ's Emergency Response Organisation needs to be activated, it will be located in the plant's Alarm Coordination Centre (ACC). A plan to improve the ERC facilities has been implemented. Backup facilities have been prepared for all primary facilities, including an off-site facility for the site emergency director and his technical support staff.

The LH has developed further its set of Extensive Damage Mitigation Guidelines (EDMGs). They address gross infrastructure problems deriving from a major incident, e.g. blocked roads, or doors no longer amenable for access.

16.1.a.6 Training of the emergency organisation of the LH

Both operators and other staff are given frequent training in the use of emergency operating procedures. This takes the form of courses on the full-scope simulator, and through emergency exercises at the plant. A data link for the process computer has been created between the plant and the simulator to enable calculating real time accident progression data in the phases before core melt to be monitored during an exercise by the staff at the plant. This simulator process data can also be transferred in real time to the ANVS in The Hague and to the severe accident support centre of Framatome, located in Erlangen, Germany. It is also possible to transfer the process data of the plant itself through these data links to the ANVS and to Framatome.

The training requirements are described in the various procedures and in the manual on emergency drills. Training, drills and exercises take into account the Post-Fukushima plant modifications, the use of mobile equipment, backup emergency facilities, et cetera. The plant management is required to provide a schedule of regular emergency drills and classroom trainings. A part of the obligatory training plan for shift staff is devoted explicitly to dealing with emergencies.

Trainings and emergency exercises are conducted routinely and include change-over of ERO shifts. The LH produces an annual summary report of its exercises which is assessed by the regulator. Each year the LH conducts a series of seven full-scale exercises, which are based on a multi-year exercise plan. The LH invites the authorities to participate in these exercises. The ANVS participates in six emergency exercises annually. One or two ANVS-inspectors are located at the ERO location to observe the exercise and to act as liaison on-site between the LH's ERO and the Task Force "Emergency Situation". This Task Force is part of the Crisis Expert Team - radiological and nuclear (CETsn) which is itself part of the national crisis structure of and is responsible for the technical analyses of the accident (see also paragraph 16.1.b.4).

The LH has strengthened its communication strategy in its emergency plans, both to address own personnel and their families, and to address the general public in the different phases of accident progression.

Interfacing with the national and regional response organisations is exercised in the integral exercises; usually all interfaces are exercised in at least 1 of the 7 exercises. The LH is required to send a liaison to the regional emergency response centre, who can aid coordination of activities and explain information provided by the LH.

Evaluation of past exercises learnt that informing LH's own personnel and communication with the general public required another approach within the LH's emergency plans. Communications has become a very important aspect in the current emergency plans.

16.1(b) Off-site: EP&R and PAM

Off-site emergency preparedness and response (EP&R) and post-accident management (PAM) mainly is a responsibility of the authorities. Nevertheless utility's responsibility is also important especially regarding providing technical information on plant conditions and the potential risk for emissions.

The present section gives a general introduction to the EP&R and PAM in the Netherlands.

16.1.b.1 Regulatory and organisational framework for off-site EP&R

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 organising an effective response to nuclear accidents and for coordinating that response. The operational structure of nuclear emergency preparation and response is based on Article 41 of the Act and is detailed in the National Emergency Radiation Plan (LCP-S[69]).

16.1.b.2 Distinction between category A-objects and category B-objects

In the National Emergency Radiation Plan, 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 like the Borssele NPP. Radiological labs and waste management facilities would be classified as category B-objects.

The Plan details the structure and responsibilities of the various organisations involved in nuclear emergency management, including the relationship with the regional arrangements of the Safety Region (Dutch: 'Veiligheidsregio'). It also describes the emergency types of all the IAEA emergency preparedness categories (I-V) of potential nuclear and radiological accidents and incidents including specific measures.

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 etc.). However in the first hours after the accident the chairperson of the regional Safety Region, in the event of an accident with a category-A object, will take measures and issue instructions that are within the scope of the ministers concerned. He will inform the ministers and other parties (including the ANVS) within the national crisis organisation structure. Later on the responsible minister may order to withdraw certain measures or to change them in certain ways. Coordination takes place within the scaled-up national crisis structure.

For accidents with category B-objects, the chairperson of the Safety Region or the mayor of the municipality, depending on the scale of the incident, is responsible for the emergency response. Accidents with category B-objects can develop to category A. With this type of accident, local authorities

[69] Dutch: 'LCP-S' is 'Landelijk Crisisplan Straling', i.e. national emergency radiation plan

can be advised on request by a national team of experts on such emergency situations, the CETsn[70]. More on CETsn can be found below.

16.1.b.3 Responsibilities of Ministers

The Minister of I&W coordinates efforts on emergency management specific to nuclear accidents of national relevance (the 'category-A accidents) via the Departmental Crisis Coordination Centre of I&W (DCC[71] , also referred to as DCC-I&W). The Minister is also responsible (if necessary, together with other government ministers) for the appropriate provision of information to the Dutch public and those involved in accident response. To that end, the DCC works closely with I&W's Crisis Communication Directorate, which is responsible for crisis communication. The ANVS also has an important role; refer to text below on national organisations for EP&R.

The Minister of Justice and Security ('Justitie en Veiligheid', JenV) coordinates efforts on the general management of accidents at the national level and oversees the preparation and maintenance of regional crisis management plans (for all types of accidents and emergencies). It is also responsible for the National Crisis Centre (NCC) that serves as national coordination centre during incidents when the involvement of various ministries is required. The Minister of JenV is also responsible for maintaining the rule of law in the Netherlands. The other ministers have responsibilities that are linked to areas that are specific for their own ministries. Examples are:

- Minister of Health, Welfare and Sport for medical aspects and public health;
- Minister of Social Affairs and Employment: for occupational safety;
- Minister of Defence: for accidents with military nuclear materials.

All these responsibilities are further described in the National Emergency Radiation Plan.

16.1.b.4 Connection to the knowledge and advice network (CETsn)

The ANVS is responsible for the Crisis Expert Team – radiation and nuclear, the CETsn. The CETsn is the knowledge and advice network that brings together the knowledge and expertise in the field of nuclear safety and radiation protection of various radiation protection via experts from various institutes and is part of the national crisis infrastructure. As a result, the CETsn is able to collect and interpret the information available in the event of a radiation accident and, on that basis, to formulate substantive advice on the response. The ANVS provides the chairperson of the CETsn. The associated institutes remain responsible for the quality of their products and services. Advices of CETsn concern the factual situation as well as expected developments.

CETsn can be scaled-up, various entities will get involved when needed. The CETsn has several back offices, the Task Force "Emergency Situation", the REMM (Radiological Expert Team Measurements & Modelling), Communication and Office CAAC (Competent Authority and the ANVS Crisis Desk).

Back offices and their roles are:

- The Task Force "Emergency Situation" has an important role in assessing the status of the relevant nuclear installation or accident area, the accident prognoses and worst case scenario including the potential source terms. In addition, an Task Force liaison goes to the accident site to closely monitor the event and support the oversight process.
- The REMM (Radiological Expert Team Measurement & Modelling). It includes RIVM (National Institute for Public Health and the Environment). RIVM can provide for radiological information on projected dose data on the basis of dispersion calculations and on monitoring data concerning the environment (air and soil). RIVM operates the national radiological monitoring network (NMR) and

[70] Dutch: 'Crisis Expert Team – straling en nucleair', CETsn

[71] Dutch: 'Departementaal Coördinatiecentrum Crisisbeheersing', DCC

in addition mobile monitoring units (including vehicles). The REMM uses also the input form It also collects data from other institutes:

- KNMI, the Royal Netherlands Meteorological Institute, provides meteorological information relevant for the spread of emissions of radiological contaminants;
- WFSR, Wageningen Food Safety Research, is an institute of Wageningen University specialised in food safety;
- RWS (Rijkswaterstaat), the public body in the Netherlands responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands. It can provide measurements and modelling of contamination of the sea and surface waters, water soil, biota and sewage sludge;
- KWR, a research institute which conducts research into the treatment of wastewater and the reuse of the water, resources and energy it contains. It forms the link between the drinking water laboratories that perform measurements on the contamination of raw water and drinking water and the RGEN;
- Ministry of Defence, section CEAG – with expertise on occupational health and safety. It has mobile measuring capabilities. It also supports the Task Force "Emergency Situation";
- UMCU/NVIC, University Medical Centre Utrecht, with NVIC being its department with expertise on toxicology. Can give recommendations related to protection of the health of citizens and aid workers.

- ANVS Communication advises on crisis communication, based on the information provided by the CETsn. This information and advice is intended for regional and national crisis partners.
- Office CAAC fulfills the international obligations as Competent Authority (Domestic and Abroad) for notifications and information exchange during nuclear and radiological emergencies and it is also operates as the 24/7 National Warning Point.

16.1.b.5 Intervention levels and reference levels

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 and IAEA guidelines. They can be found in the Emergency Radiation Plan, which is also available online[72]. With the adaptation of this new Crisis Plan a number of changes has been made regarding the intervention levels. There is no longer a range for the intervention levels (dose criteria) for the measures evacuation, sheltering and Iodine Thyroid Blocking, and the duration of these measures has been extended from 48 hrs to 7 days.

With the implementation of the EURATOM directive Basic Safety Standards in Dutch regulations (Decree and Regulation on Basic Safety Standard for Radiation Protection) also a number of reference levels were set. For the protection of the public during emergency situations (article 9.2 of the Rbs) the reference level is set at 100 mSv acute or annual effective dose. For the transition phase and the existing situation the level is set on 20 mSv annual effective dose.

Also for emergency workers reference levels are set (article 7.37 of the Bbs) for specific types of activities. These are 100 mSv, 250 mSv and 500 mSv effective dose respectively. If dose levels exceed 100 mSv, the employer makes sure that the emergency worker has been clearly and extensively informed in advance about the associated health risks and voluntarily carries out the relevant activities.

16.1.b.6 Emergency planning zones

The policy regarding planning zones has been evaluated by the parties involved, 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 accident country. This is in line

[72] https://www.rijksoverheid.nl/documenten/rapporten/2021/04/30/landelijk-crisisplan-straling

with the HERCA-WENRA approach. In case of an emergency in the Netherlands, protective actions will be based on the Dutch policy on EP&R and associated intervention levels. In order to do so, the planning zones have been aligned with that of the neighbouring countries.

The Netherlands is actively involved in the HERCA/WENRA initiatives to harmonize the approach for nuclear and radiological accidents.

Dimensions of emergency planning zones for Borssele NPP

There is a regional crisis management plan for accidents at this nuclear installation. There are planning zones for which certain measures have been prepared. The sizes of these zones have been established based on reference scenarios, harmonisation with neighbouring countries and international insights. Depending on the severity of the incident in the actual response phase, the intervention zones where countermeasures will be taken may be smaller or bigger than the planning zones.

Criteria for classification of emergency situations at Borssele NPP

Following consultation with the ANVS, Borssele NPP has adopted the four classification levels in the IAEA system for use in its Emergency Plan. Each level is associated with incident/accident parameters ranging from a small fire to a large actual off-site release. Difficult elements to capture in the criteria are potential/probable consequences which have not yet occurred but which nevertheless call for larger-scale protection and prevention measures. To address this, the LH uses precursor criteria such as critical safety function status, spent fuel pool level and availability of the main control room and specific parameters for emissions of noble gasses and iodine. Exceeding these criteria triggers the specific emergency class. With the new Emergency Radiation Plan the emergency classifications are renamed following these from the IAEA. So the new names are Alert, Facility Emergency, Site Area Emergency and General Emergency.

With an incident/accident at the NPP, the LH will initially determine the classification of it. The CETsn will assess the classification and the chairperson of the CETsn will determine this classification and the moment when this will be communicated.

16.1.b.7 Post-accident recovery

In the Emergency Radiation Plan it is described how the crisis organisation can be scaled down by the highest activated authority (mayor, chairman of the safety region or Minister). After the response phase and the accompanying crisis scaling-up, there is the post-crisis phase, the phase after the national crisis structure has been scaled down, aimed at recovery and aftercare.

In the post-crisis phase, a detailed aftercare plan should be drawn up, based on the specific situation and in line with national policy on aftercare and restoration or remediation. Reference levels are established for the exposure of members of the public in the transition from a radiological emergency to an existing exposure situation, in particular when terminating long-term protective measures such as relocation elsewhere are contained in the Decree on Basic Safety Standards for Radiation Protection (Bbs). In addition, the Appendix of the Decree requires that for transition from an emergency exposure situation to an existing exposure situation, recovery and remediation must be included in an emergency response system.

16.1.b.8 Training exercises and their organisation

The Dutch training and exercise programme for nuclear emergency preparedness and response is implemented in the annual programmes of the parties involved. Training is organised for different topics e.g. the use of Emergency Information and Decision Support Systems, and some exercises. A full-scale exercise is planned approximately every five years. In these national exercises the interaction between generic national emergency management structures, regional and local nuclear emergency management and response and the emergency management of the nuclear facility are integrated. National large scale exercises were conducted in 2005, 2011 (‘Indian Summer’, 2018 (‘Shining Spring’), and 2024 (Autumn Glow) while a smaller one was conducted in 2017. In the exercises of 2017 and 2018, Belgian authorities were involved. In the exercise of 2024 Belgium took part as an observer. The next large-scale exercise in the Netherlands will take place in 2029/2030.

Officials of different departments and organisations participate in exercises and trainings. They all have their own expertise and roles during such an exercise and during an actual accident-response. Examples of such roles are performing radiological/technical analyses, advising on health aspect, et cetera.

Nuclear and radiological training exercises are both organised by the ANVS and the Minister of I&W, depending on the scale of the exercise. The Ministry of J&S (Justice and Security) is responsible for the generic national response organisation and for exercises to train this organisation. Ministries work together in the organisation of integrated large scale exercises.

The ANVS not only participates in specific nuclear or radiological exercises, but also participates in national exercises with another scope, for example cyber security exercises.

As part of the training and exercise programme there is also participation in the several international exercises organised by the IAEA (ConvEx) and European Commission (ECUREX).

16.2 Providing information to the public and neighbouring states

16.2(a) Arrangements to inform the public

Chapter VI of the Nuclear Energy Act also addresses (in Article 43) the provision of information to those members of the population who might be affected by a nuclear accident. Subordinate regulation also addresses this topic. Among others, there is the Ministerial Ordinance on Nuclear Safety[73] (MR-NV) which in its Article 17 states some requirements on provision of information. Consistent with its responsibility for managing the response to a (potential) nuclear accident, the national government is responsible for informing the public. This will be done in close cooperation with the local authorities in the threatened or affected area.

In case of a threat or emergency that needs national coordination, and needs the involvement of various ministries, a national crisis communication centre as part of the NCC, is set up to inform the public. In case of an accident the CETsn will provide the NCC with accurate information. Experts from the various ministries will support the local and regional public information units based on the communication strategy for nuclear and radiological emergencies. Public information about the potential risks of nuclear power plants and the existing emergency plans is provided by the municipalities. The material needed for the information may be provided by central government, as has been the case for the municipalities in the vicinity of the Borssele and Doel NPPs, the latter being in Belgium but close to the Dutch border.

The ANVS is responsible for the communication to the public about the potential risks of nuclear power plants and radiation protection in general. The ANVS website has information on those risks and also a section dedicated to emergency preparedness and response.

The National Emergency Radiation Plan describes the arrangements for providing information to the general public in case of a nuclear or radiological emergency.

In addition, the governmental websites of various ministries have a link to the topic of ‘crises’, where information can be found on numerous aspects of nuclear and radiological emergencies.

16.2(b) Arrangements to inform competent authorities in neighbouring states

The provision of information to the authorities in neighbouring countries is the subject of Memoranda of Understanding (MoU) that have been signed with bordering countries. The exchange of technical data (such as monitoring results and modelling-assessments), reports and measures takes place on a regular basis and in a response-phase between the Netherlands and Germany. With Belgium, the same approach is in preparation phase. Information exchange at the international level is regulated by the Early Notification Convention of the IAEA and the European Commission’s Decision[74] on urgent information

[73] Which in 2017 resulted from the transposition of the amended European Nuclear Safety Directive

[74] 87/600/EURATOM: Council Decision of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency

exchange. On bilateral bases, information about (potential) nuclear or radiological emergencies will be exchanged between the respective national emergency coordination centres.

At a national level the ANVS is, as competent regulatory authority, improving the arrangements for better and efficient information-exchange and compatibility of countermeasures with the neighbouring countries Belgium and Germany.

16.2(c) Evaluations regarding emergency preparedness

The Dutch, Belgian, British and German counterparts on emergency preparedness share expertise and experience in regular meetings and undertake activities aiming to increase cooperation and mutual understanding. The Netherlands and Belgium have signed a MoU on their cooperation, there is a MoU between the Netherlands and the United Kingdom and there is a MoU for the cooperation between the Netherlands and Germany. Furthermore there are yearly higher-level meetings with the German counterparts of the ANVS.

There are regular meetings of the Dutch-German Commission for Nuclear Facilities in the Border Region ('Niederländisch-Deutsche Kommission für grenznahe kerntechnische Einrichtungen' - NDKK) and the Belgian-Dutch Radiation Accidents Consultation ('Belgisch Nederlands Stralingsongevallen Overleg' – BNSO). Both the national and the regional level authorities participate in these meetings. The ANVS and the UK counterparts have started DUNE (Dutch United Kingdom Nuclear Emergencies), an initiative to exchange information on the subject of EP&R, in 2020.

In the IRRS mission of 2023 to the Netherlands the review team observed for module 10 (Emergency Preparedness and Response) that the Netherlands had put in place an adequate operational emergency preparedness and response capability for radiological and nuclear emergencies and established a comprehensive bilateral and multilateral exchange with the neighbouring countries.

The team also observed that some requirements for emergency preparedness and response were not in full compliance with the IAEA safety standards. For example, the development of a comprehensive protection strategy, a policy for the waste management generated during an emergency, the need to have in place arrangements for the protection of helpers in a nuclear and radiological emergency and criteria for the termination of an emergency. An action plan has been drawn up for the next few years to implement the recommendations.

The IRRS team considers the creation of the CalNET as a Good Practice of the Netherlands on complying with the Standards. The CalNET information system forms a robust basis for a coordinated emergency response for national and cross-border coordination of protective actions during the early phase of a nuclear accident.

In 2024 a large-scale exercise was held ('Autumn Glow').

Both the outcome of the IRRS 2023 mission and the evaluation of the large scale exercise will be used for the update of the National Emergency Radiation Plan (LCP-S).

16.3 Summary of Significant Changes Since Previous Report

- The structure of the CETsn has been improved.
- In October 2024 the exercise Autumn Glow took place.

Article 17. Siting

17. Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

i. for evaluating all relevant site related factors likely to affect the safety of a nuclear installation for its projected lifetime;

ii. for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

iii. for re-evaluating as necessary all relevant factors referred to in subparagraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

iv. for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

The Kingdom of the Netherlands fulfills the obligations of Article 17.

17.1 Evaluation of site-related factors

Arrangements and regulatory requirements related to siting and evaluation of sites of nuclear installations

The Acts applicable to licensing of a nuclear installation have been listed in the text on Article 7. Main examples are the Nuclear Energy Act (Kew), the Environment and Planning Act and the General Administrative Act (Awb). Also several Decrees and Ordinances apply; they too can be found in the text on Article 7.

There are also several Nuclear Safety Rules (based on IAEA guides) that apply to the site evaluation. These are referenced in the licence of the installation, and for the Borssele NPP can be found in Appendix 4. Examples of relevant NVRs are NS-R-1 (Safety of NPPs – Design[75]), NVR NS-R-3 'Site Evaluation for Nuclear Installations', and NVR NS-G-3.1 'External Human Induced Events in Site Evaluation for NPPs'. This means that the NPP needs to satisfy all requirements mentioned in these guides to maintain its licence.

Furthermore, the Dutch 'Safety Guidelines' [76](VOBK) established in 2015 provide, among others, guidance on siting issues for new nuclear reactors. IAEA recommendations have been incorporated, derived from various documents, like NS-R-3 'Site Evaluation for Nuclear Facilities'. Although the Safety Guidelines do not have the status of (ministerial) Regulations and do not therefore define any legal requirements, licence applications will be assessed on the basis of the safety requirements described in these Safety Guidelines. For more information on the VOBK refer to the chapter on Article 7.

At the time of the construction of the Borssele NPP, other rules applied to the site evaluation than today. However in the various licence applications for modifications, updates of the Safety Analyses Report and Safety Report and the associated various Periodic Safety Reviews (PSRs), appropriate attention has been given to site specific threats to the facility. For more information on PSRs refer to the section on Article 14.

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[75] NS-R-1 has been superseded by the publication SSR 2/1 (Rev.1) which has the same title as its predecessor

[76] Dutch: 'Handreiking VOBK', introduced in the present report in the section on Article 7 of the CNS

The safety case of Borssele evaluates the site-related external threats from natural origin and human origin. Those from human origin may generally result from an accident in the nearby industrial environment, from pipelines, from an accident on a nearby road or railway or the river and from an aircraft crash. An example of a potential human induced hazard considered is an explosion induced by an accident with a transport of liquefied gas on the river Schelde near the site. To counter delayed ignition of a vapour cloud, an automatic detection and ignition system has been installed on the seaward side of the levee.

Hazards from natural origin considered are earthquakes, storms and other extreme weather conditions, and floods. The resulting risks for these events have been evaluated in the Probabilistic Safety Assessment (PSA) for external events and were found to be very low. Given the history and characteristics of the Netherlands, flooding is a hazard that is taken very seriously and that has been thoroughly assessed for the Borssele site. The levees near the site offer protection, and in case of flooding the calculated pressure waves will not harm the installation.

Future expectations of climate change are part of regular licensing, safety analysis, and periodic safety reviews. As such, nuclear installations already have design margins to cope with expected future climate change. To share experiences and possible challenges related to climate change, the ANVS is also involved in an informal cooperation with the UK, Belgian and French regulators, initiated by the UK regulator, since 2024.

Post-Fukushima Daiichi external hazards have received increased attention, also those that may have an impact on supporting infrastructures like power lines and access roads. In Europe activities have been coordinated by ENSREG. All EU member states have drafted and implemented National Action Plans (NAcPs) that describe the status of post-Fukushima Daiichi activities. The activities related to the NAcP have more or less merged with the activities that are a follow-up of the PSR. Therefore post-Fukushima Daiichi lessons learned will remain part of the continuous improvement cycle at the NPP that is embodied in the PSRs.

For more details of design provisions used against site-related external events (of human and natural origin) for the Borssele NPP, refer to the chapter on Article 18 (Design).

Regulatory review and control activities - Supervision

In the current situation there is no separate site licence or a site permit. This means that the ANVS does not have a formal oversight possibility until a construction licence is given. Review of the site related issues will be part of the SAR review for the construction licence of new nuclear installations.

The ANVS supervises the implementation of measures at Borssele NPP associated with site-related factors, as decided on the basis of the PSR and the ‘stress test’ analysis.

17.2 Impact of installation on individuals, society, and environment

Criteria for evaluating likely impact on population and environment and their implementation in the licensing process

Before a licence is granted, the applicant has to specify all relevant site-related factors that may affect the safety of the plant. Examples of site-related factors are events induced by human activities, such as aircraft crashes or gas cloud explosions, and events due to natural causes such as seismic phenomena and high tides. To assess the potential impact of an accident, all kind of site-related data needs to be collected, like population distribution, residence time of various population groups in the area, use of land water, meteorological statistics et cetera. These data need to be kept up to date, and in effect this is guaranteed with the cycle of PSRs. Such information is also input for the required Environment Impact Assessment.

In September 2009 the third Electricity Supply Structural Plan (SEV III [77]) became operational. SEV-III , as well as the Environmental Quality Degree of the Netherlands, reserves space for large-scale production and transport of electricity. In SEV-III, on the basis of a preliminary selection procedure, three locations

[77] Structuurschema Elektriciteitsvoorziening III

have been selected and in principle warranted for the siting of a nuclear power plant. Is does not imply that other locations are not be suitable for NPPs. The site selection process during the licensing procedure should further assess the consequences and the suitability of the site. There are no specific locations selected for other nuclear installations (not being NPPs). However, in the licensing process, the suitability of the site has to assessed, considering potential consequences of the operation of the installation for the surrounding area. This might become more important with the consideration of potential SMR-projects.

The main site-relevant factors that have been taken into account in the preliminary selection are:

- Any special circumstances which prohibit the building of a nuclear power plant on a particular site, e.g. the presence of an airport or of industries with the potential for the release of explosive or toxic substances in the vicinity, or certain difficulties involving the existing electrical power grid;
- The population density within a radius of 20 km around the site, and especially in the most densely populated 45° sector around it. If these weighted population densities are too high compared with the weighted population densities for a reference site, the proposed site will be removed from the initial list.

17.3 Re-evaluating of relevant factors

Actions under the responsibility of the Licence Holder

The Licence Holder (LH) is by law bound to 'continuous improvement' of the safety of the nuclear installation. This means also periodically and systematically perform safety assessments, the PSRs. The licence describes the nature of these assessments and also specifies the maximum period between them. For example, the safety of the nuclear power plant as a whole must be re-evaluated every 10 years in the light of new safety insights and generally accepted safety practices. Account must be taken of 'site-relevant factors' as mentioned in the section on Article 17.2. Also refer to the section on Article 14 for the PSRs.

In addition after the accident at the Fukushima Daiichi nuclear power station in 2011, the European Complementary Safety Assessment (CSA) or 'stress test' was conducted and this resulted in the NAcP mentioned before in section 17.1. In this assessment, site related aspects have been given extra consideration. Threats like flooding and earthquakes with magnitudes of very low probability have been considered in this safety margin assessment. Also combinations of natural hazards were considered; but this was already the case in the conventional PSRs. Associated with this, the consequences of (and mitigation of) loss of infrastructure and site access have been evaluated. The post-Fukushima Daiichi lessons learned on site related hazards will remain part of the continuous improvement cycle at the NPP that is embodied in the PSRs.

Regulatory review and control activities

The RB monitors the progress of implementation of the NAcP, including those that are site-related. The PSRs are also reviewed by the RB and the process of any required action resulting from a PSR is also monitored. There are improvements that have been required by the RB.

17.4 Consultation with other contracting parties

The procedure for obtaining a construction licence for a nuclear installation includes an obligation to submit an Environmental Impact Assessment (EIA). As part of this procedure, neighbouring countries that could be affected by the installation are notified on the basis of the Espoo Treaty and an EU Directive:

- The Espoo Treaty of 26 February 1991. The Netherlands ratified this treaty on 28 February 1995 and the European Union ratified it on 24 June 1997; the treaty came into force in September 1997.
- Council Directive 97/11/EC of 3 March 1997, amending Directive 85/337/EEC on the assessment of the effects of certain public-sector and private-sector projects on the environment. The Espoo Treaty has been subsumed under this Council Directive.

The Netherlands has incorporated the provisions of the Espoo Treaty and the EU Directive into its Environmental Protection Act. Chapter 7 of this Act deals with environmental impact assessments and the relevant procedures. These include the provision of information to neighbouring countries and the participation of the authorities and the general public.

A special bilateral committee for nuclear installations (NDKK[78]) has been set up with Germany to promote an effective exchange of information between the two countries. Originally the prime function of the NDKK (established in 1977) was to improve and guide participation by citizens (living in the proximity of the border) in the licensing procedures of the neighbouring state. Later, it assumed the additional function of a platform for the exchange of information on more general nuclear topics such as the technical aspects of installations near the border, developments in regulations and emergency preparedness activities.

A bilateral Memorandum of Understanding (MoU) of a similar nature has been agreed with Belgium.

The government is also bound by the provisions of Article 37 of the EURATOM Treaty, under which all relevant data on the safety and environmental impacts of any nuclear installation that could affect a neighbouring EU Member State must be submitted to the Article 37 Expert Group before a licence can be issued by the Regulatory Body. This Expert Group advises the European Commission on the acceptability of the proposed installation on the basis of safety evaluations. The Commission thereafter informs the Member States concerned of the outcome of these evaluations.

[78] The NDKK is the Dutch-German committee for nuclear installations in the border regions

Article 18. Design and Construction

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

i. the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence-in-depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

ii. the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

iii. the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

The Kingdom of the Netherlands fulfills the obligations of Article 18.

18.1 Implementation of Defence in Depth

Overview of the Contracting Party's arrangements and regulatory requirements concerning the design and construction of nuclear installations

In the Netherlands the IAEA standards play an important role in the regulatory framework. IAEA standards are applied in amended form as NVRs. Currently the NVRs that are applicable contain the amended IAEA design requirements NVR-NS-R1 and guides NVR-NS-G-1.1 through G-1.13 and NVR 2.1.1 (classification of systems and components), an amended version of SS 50-SG-D1. Except the NVR 2.1.1, the NVR's for design have been formally introduced as licence conditions for the Borssele NPP in 2011. The NPP has to comply with these as far as reasonably achievable.

The defence-in-depth concept to be applied is defined in NVR-NS-R-1 'Safety Requirements for Nuclear Power Plant Design'. 'Defence-in-depth' is the name given to a safety philosophy consisting of a set of diverse and overlapping strategies or measures, known as 'levels of defence'. An important principle is that the means provided on one level of defence should be independent from those of other levels. This ensures that the failure of one system will not affect more than one level of defence.

Structures, Systems and Components

The identification and classification of the function and significance of structures, systems and components on safety is based on NVR 2.1.1. This Safety guide is an amended version of SS 50-SG-D1 defining four safety classes. Classes 1 to 3 are equivalent to the first three safety classes of SS 50-SG-D1. Class 4 is an extension for:

- Components whose malfunction or failure could put a demand on a safety system in case of an anticipated operational occurrence;
- Components whose malfunction or failure could lead to a significant release of radioactive materials and/or could cause a significant exposure of the site personnel or the public and for which no safety system might be provided;
- Components that may perform significant functions with respect to the prevention, termination or mitigation of anticipated operational occurrences and/or accident conditions, including severe accidents. A function is considered to be 'significant' if it ultimately improves the safety level of the plant.

For system and component design, acceptance criteria are being used based on standard engineering practices. The responsible contractor is left free to choose which specific code to use – within the restrictions of respective safety guides. The RB assesses the selected code and may formulate additional acceptance criteria. By allowing the contractor to work with a familiar code the occurrence of inadvertent errors may be reduced.

The original design and construction Safety-relevant fluid-retaining components of Borssele NPP (safety classes 1, 2 and 3, as defined by NVR 2.1.1) were designed and constructed in accordance with the earlier ASME Code, Section III, Division 1 'Code for the Operation and Maintenance of Nuclear Power Plants', the Dutch Design Code for pressure-retaining equipment, and various Siemens/KWU component specifications. In the 1990s a selection of KTA safety codes was introduced at Borssele NPP including significant additional operational experience.

Conventional electrical installations must comply with standards NEN 1010 and NEN 3410 and electrical equipment, where applicable, to NEN 3125 and NEN-EN 50.014 up to 50.020. The design codes and standards used for nuclear electrical installations are the IEEE standards and a set of KTA codes. For digital equipment the standards are used that are provided by the International Electro technical Commission (IEC), the European Committee for Electro technical Standardisation (CENELEC) and the Verband der Elektrotechnik, Elektronik und Informationstechnik e.V. (VDE).

To prevent propagation of a failure from a system classified in a lower safety class into a system classified in a higher safety class, NVR-NS-R-1 prescribes that appropriate independence must be maintained between systems or components of different safety classes. This independence can be achieved by using functional isolation and physical separation.

The Borssele NPP is a two-loop system that was built in the 1970s. Therefore, in the original design physical separation was limited. In the first 10-yearly Periodic Safety Review (PSR), a significant effort was put into creating a physical separation between redundant systems of the two loops. This separation was further improved in the second and third 10-yearly PSR. The evaluation report of the third PSR was published in 2013. A number of measures resulting from this PSR have been merged with measures that resulted from the European stress test. Some of these are related to physical separation. All of the measures from these evaluations have been implemented. The last PSR in 2023 highlighted some issues that had not been identified before; further improvements have been planned. Appendix 4 contains a further description of this.

A selection of current developments in the regulatory framework:

- In 2014 the update of the 2009 European Nuclear Safety Directive has been published and it has been implemented in the Dutch regulatory framework in August 2017. This regulation also contains binding requirements for defence-in-depth and periodic safety review. In addition, the practical elimination of off-site radiological consequences for new reactors, has also to be applied to existing reactors as far as reasonably achievable. The European Nuclear Safety Directive more or less covers the WENRA Objectives for new reactors and the Vienna declaration.
- In September 2014 WENRA has published its updated Reference Levels for existing reactors, based on the lessons learned from Fukushima. About 75% of these were already covered but 25% of the new/modified RLs needed implementation via the licence – as has been achieved. In October 2015 the ANVS published the VOBK[79], the non-binding Guidelines on the Safe Design and Operation of Nuclear Reactors - Safety Guidelines. These Guidelines provide new reactor licence applicants with detailed insight into what the ANVS considers to be the best available technology. More details about the document can be found in the text on Article 7. The VOBK has been developed in preparation for the new build plans for research reactor PALLAS and plans of two other companies for new NPPs. The VOBK was developed with the assistance of the German TSO GRS. The VOBK is considered to be state-of-the art, also covering the recent update of the IAEA document SSR1/2. Currently, the VOBK is under evaluation and a new version is expected to be published in 2025.

[79] Dutch: Veilig Ontwerp en het veilig Bedrijven van Kernreactoren, VOBK

Beginning 2021, WENRA published a new update of its RLs. Relevant IAEA Safety Guides and WENRA RLs will be implemented by reference in guides ('Handreikingen'), issued by the ANVS.

Status with regard to the application for all nuclear installations of the defence in depth concept

Currently the Borssele NPP meets the requirements regarding the defence-in-depth concept. Its compliance is summarised below:

- The first level of defence shall prevent abnormal operation and failures. Operational experience, especially as indicated by collected plant-specific component failure data, data resulting from the non-destructive testing of the primary pressure boundary, as well as the programmes for inspection, maintenance, testing, ageing etc. applied to plant systems and components, has shown that the first level of defence is adequately preserved.
- The second level of defence shall control abnormal operation and detect failures in a timely manner. In the Operational Limits and Conditions (OLC) document the limits are defined within which the Borssele NPP must operate. In order to ensure that the limits are not exceeded, the safety systems are subject to an extensive set of in service inspection, surveillance and maintenance procedures. These procedures together with the Operational Limits and Conditions document form the second level of defence.
- The third level of defence shall control accidents within the design basis. The essential means provided consist of the safety systems and other measures to control Postulated Initiating Events (PIEs) including Limiting Design Basis Events. The safety analyses that are reported in the Safety Report have to prove that the radiological consequences of design-basis events meet the radiological criteria. These radiological criteria specify smaller acceptance doses if the assumed frequency of the PIEs increases. These criteria are specified in Appendix 1.
- The fourth level of defence shall control severe plant conditions. This is realised by the symptom-based Emergency Operating Procedures (EOPs) and the Severe Accident Management Guidelines (SAMGs), that need to prevent or mitigate consequences of severe accidents should they happen despite the presence of levels 1-3.
- The fifth level of defence shall mitigate the radiological consequences of significant releases of radioactive materials in the unlikely event that they would occur. It is covered by the strategies for off-site emergency preparedness. See the section on Article 16 for more information on these strategies.

Safety Analysis

The Safety Report (SR) of the Borssele NPP is a one-volume document of little less than 700 pages. In this report a condensed representation is given of all safety related aspects regarding the installation and its surroundings. In addition to the Safety Report, the twenty-volume Safety Analysis Report (SAR), also known as the 'Technical Information Package' (TIP), provides extensive background information on all safety-related aspects regarding the installation, plant layout and the safety analyses. The SAR also includes all details of the design base accident (DBA) analyses. The licence of Borssele NPP requires keeping the SAR/TIP up-to-date at all times.

The SAR is the starting point for all modifications and maintenance activities and is updated with each modification.

In parallel to the third PSR, a new SR and SAR have been developed. The SAR (TIP) is based on the recent set IAEA safety guides.

NVR-NS-R1 (Safety Requirements for Nuclear Power Plant Design) and NVR-SSG-2 (Deterministic Safety Analysis) state that a full range of events must be postulated in order to ensure that all credible events with potential for serious consequences and significant probability have been anticipated and can be accommodated by the design base of the plant. Appendix 1 specifies the acceptance criteria for the analysis. Refer to the section on Article 14 for regulatory requirements governing the issuance of SARs (and SRs) or their updates.

For the safety analysis of the Borssele NPP, the postulated initiating events have been defined in the following categories according to their entrance probability:

- Cat. 1 Normal operation (10^{-2} - 1/reactor year);

- Cat. 1 Anticipated operational occurrences (10^{-2} – 1/reactor year);

- Cat. 2 Design Basis Accidents (10^{-4} – 10^{-2}/reactor year);

- Cat. 3 Beyond Design Basis Accidents (10^{-6} - 10^{-4}/reactor year);

- Cat. 4 Severe Accidents (< 10^{-6}/reactor year).

Further the PIEs are grouped according to the following set of threats:

1) Increased heat removal by the secondary cooling system;
2) Decreased heat removal by the secondary cooling system;
3) Decrease in flow in the primary cooling system;
4) Pressure changes in the primary system;
5) Inadvertent changes in reactivity and power distribution;
6) Increase of cooling inventory in the primary system;
7) Leakage of cooling inventory from the primary system;
8) Radioactive releases from subsystems and components;
9) External events (containing among others earthquakes, plane crashes, flooding and external fires);
10) Miscellaneous (containing among others fire and explosions inside the power plant, internal flooding of safety relevant buildings and leaks in reservoirs with highly energetic contents inside the reactor building).

In the overhauled and updated safety report that was used for the modification licence application in 2015, there is a basic list of 81 PIEs from the original design and an additional list of 59 PIEs.

The additional list gives also more attention to events for the spent fuel pool (14 out of 59).

From the basic list of postulated initiating events, a selection has been made of a group of representative enveloping events that cover the consequences of all these events. Then for all PIEs on the additional list it is analysed if they are already covered or not. The result was that in the category 2 (DBA) three additional representative PIEs were added:

- Formation of low boron concentration area’s in the primary circuit (internal de-boration);
- Leakage of 20 cm2 in the RPV, below the top of the core;
- Breach of a control rod case with control-rod ejection.

In the category 3 (beyond design) two representative cases of ATWS are added: emergency power and ATWS and total loss of main feedwater and ATWS. All other PIEs of this category are considered manageable with the existing provisions and additional measures taken for instance based on the stress test and PSR.

In the category 4 (severe accidents) the probabilistic safety analysis is used. This is not subject to this article.

Where it is credible that combinations of randomly occurring individual events could lead to anticipated operational occurrences or accident conditions, they are considered as a basis for the design. In the case where events occur as the consequence of other events, these events are considered as a part of the original postulated event.

Already in the 1980s protection against external hazards was increased by bunkered safety systems and in the 1990s this was further improved. During the European stress test, margins against external hazards

have been evaluated. It has been concluded that these generally are sufficient and where reasonable they were further improved. The analyses for further improvements of the margins for earthquake have been finalised. The last measures to increase earthquake resistance are being implemented. The locations and level of protection for the emergency management and equipment have been enhanced. Also resilience against airplane crashes has been studied.

Extent of use of design principles

The Borssele power plant takes into account a number of design principles.

The reactor design is inherently safe, through its fuel and core design (negative T-coefficient). Several passive safety provisions are available, e.g. the barrier concept to contain fission products, safety injection tanks, the design improvements like bunkered systems to protect against external events, and PARs. The fail-safe concept has been applied from the beginning. One particular example of this are the control rods that will drop into the core when electric power fails.

Redundancy and separation were not completely established in the design stage (1970) as it should according to later insights. During the implementation of measures of the first periodic safety review (1994-1998) a lot of measures were taken to improve the situation.

Redundancy is applied for important safety systems to cope with the so called single failure criterion. For example: the low pressure safety injection and residual heat removal system has two branches (2-loop plant) and in each branch two trains. Also the electrical system has been divided into two branches, each having an emergency diesel generator, but in addition backed up by a third DG.

Separation is applied to prevent common cause failure by for instance fire or flooding or by the effect of a failure on a neighbouring redundant system. Separation was for instance improved by moving two of the three DGs that were all located in the same building, to a different location in a new building. Within the building they are in separated rooms with separated fuel tanks. Where relocations of redundant systems were not possible, other solutions were found; e.g. local physical separation was applied between these systems to reduce the risk of common cause failures.

The impact of common cause failures can be limited by the application of diversity. The design of the Borssele NPP incorporates diversity in several ways, such as diversity in process parameters (e.g. high pressure or high temperature) to initiate safety system actions, diversity in equipment's driving force (e.g. steam driven and motor driven emergency feed water pumps), and diversity in manufacturing (e.g. different manufacturers for 'normal' and 'bunkered' emergency feed water pumps). As a result of PSR a diverse cooling system for the reactor and fuel pool consisting of number of groundwater pumps have been installed. Stress test measures like the use of mobile equipment can also be considered as an application of diversity.

Another concept that is applied is called "leak before break".

Implementation of design measures or changes

During the first 10-yearly Periodic Safety Review (PSR) in the 1990s, the Borssele NPP made a thorough study on the capabilities of the installation with respect to severe accidents. Based on this study both hardware and procedural measures were taken to expand its capabilities to prevent and mitigate the consequences of a severe accident. The hardware measures involved amongst others the installation of passive hydrogen recombiners, filtered pressure relieve of the containment and filtered air supply to the control room and a separate emergency control room. The procedural measures consisted of the introduction of an extensive set of symptom-based Emergency Operating Procedures (EOPs, for prevention) and Severe Accident Management Guidelines (SAMGs for mitigation). The EOPs are based on the PWR Owners Group guidelines and consist of guidelines for the Emergency Support Centre, which initiates required actions, and procedures for the control room staff. These measures were implemented in 1994-1998.

As a result of the second 10-yearly PSR further measures have been implemented like improved extinguishing agents and capability to fight large kerosene fires, the implementation of remotely operated pressure relieve hatches to improve natural circulation inside the containment, in order to

prevent too high local hydrogen concentrations and the introduction of SAMGs for non-power conditions.

Amongst others the third PSR was used to verify how the NPP might comply with the new design requirements and guides introduced in 2011. Also the design of the plant is compared with the safety objectives of new reactors, published by the WENRA in 2010. In addition the stress test has been carried out. This resulted in further improvement possibilities. Examples of further improvements that have been implemented till 2017 to prevent of mitigate beyond design basis accidents are:

- Increasing battery capacity on emergency grid 2;
- Implementation of In Vessel Retention;
- Several additional measures to refill and cool the spent fuel pool.

Implementation of particular measures

Already mentioned are the introduction in the 1990es of the PARs, Filtered Venting, and SAMGs and in 2017 the in-vessel retention.

Improvements implemented for designs for nuclear power plants as a result of deterministic and probabilistic safety assessments

In Appendix 4 details are provided about modifications completed since the start of the power plant based on lessons learned and PSRs. The implementation of the measures of the third PSR was finished in 2017. The improvements from the complementary safety review (European Stress test) were largely implemented in the same time frame, only one measure was completed later, in 2019. The improvements made from the 'stress test' and the progress are listed in the summary and some information on a selection of them is presented in the text on Article 14.

Regulatory review and control activities

The design provisions and its modifications have to be reviewed and controlled. During the regular supervision activities elements of DiD are inspected. Special attention is given to the refuelling and maintenance stop, where in particular the minimum availability of redundant safety provisions are checked frequently. Regulatory review and control start with the licensing of modifications. After the licence is granted the regulatory supervision starts. Depending on the safety importance, detailed modification plans (also those that still have safety impact, but do not require a licence) have to be submitted to the regulator according to a procedure that has been approved. These plans are reviewed by the regulator when needed with support of a TSO. The plans are either rejected or agreed with or agreed without further conditions. Implementation is then supervised under the lead of the plant inspector, this could include FATs or SATs and commissioning.

18.2 Technology incorporated proven by experience or qualified by testing or analysis

Contracting Party's arrangements and regulatory requirements for the use of technologies

The national requirements governing proven design are based on NVR-NS-R-1. Dutch design and construction codes for pressure vessels do not contain a nuclear section. For all construction and modification activities, the LH proposes which nuclear design and construction code to use. The Dutch RB assesses the norms, standards and constructions of this code and depending on the result additional requirements are formulated. In order to ensure that the design codes used are applicable, adequate, sufficient and up-to-date only design codes have been approved that are internationally accepted, like ASME III, KTA and RCC-M.

Measures taken by the licence holders to implement proven technologies

The safety-relevant fluid retaining components of the Borssele NPP were constructed in accordance with German material specifications. For example the steam generator tubing is made of Incaloy 800 while

Inconel-600 (susceptible for PWSCC [80]) is only used for locations where stresses are low. The LTO-project has confirmed the low nil-ductility transition temperature of the reactor pressure vessel. It was confirmed that the nil-ductility transition temperature comprising 60 years of operation is even quite lower than the earlier conservatively determined nil-ductility temperature for 40 years of operation.

New mechanical components installed during the Modifications Project (1997), were made in accordance with the KTA design and construction rules, Siemens/KWU Konvoi component specifications (updated in 1992) and other international standards for nuclear products.

Advanced (and proven) technology was introduced with the Super Compact Tandem Safety Valves on the primary system, which were qualified by analysis, laboratory tests and test loop experiments.

The technology for the design and construction of safety systems and components for the Borssele NPP has been qualified by analysis, testing and experience in accordance with the requirements of the relevant safety regulations.

Examples are the introduction of new fuel elements, the large-scale replacement of electrical components and the implementation of In-Vessel Retention (realized in 2017).

Starting with the refuelling outage of 2005 new fuel elements with the improved corrosion and hydrating resisting Zirconium-Niobium cladding material M5 have been deployed. Other features of these new HTP fuel elements are the presence of a debris filter in the bottom of the fuel assembly, and new spacers to avoid grid-to-rod fretting. The M5 material had already been tested in other reactors and in laboratory experiments. The relatively high burnups of 68 MWd/tU prompted the RB to require the LH to follow the results from measurements in other plants and research facilities and report this on a yearly basis. Also for the introduction of MOX-fuel the same approach was chosen. In 2014 a first reload with lead assemblies was established.

In the 1980s, Borssele undertook a programme of partial replacement of electrical components, including instrumentation and control, in order to improve the environmental qualifications of the equipment involved. Since then, electrical components etc. in safety classes 1, 2 and 3 placed inside the containment have met the IEEE class 1E qualifications. Borssele components that must meet design-basis LOCA environmental conditions now also meet the Konvoi or VGB (Association of German Power Plant Operators) qualifications. Electrical equipment is qualified on the basis of type testing, analysis and experience. All products and services were delivered by suppliers that are either qualified by VGB or by the architect engineering company (Siemens, Framatome) under an extensive quality control programme verified by independent inspectors. Quality assurance programmes were introduced in the 1980s and resulted in the partial transfer of quality control work to suppliers. Currently the NPP has a vendor rating system.

In vessel retention (IVR) has been studied by the LH with the support of Framatome during the 10EVA13. Internationally this topic has become more important in recent years. The LH concluded that it is feasible to implement the IVR in the Borssele NPP. The ANVS requested GRS to review international experience with IVR to determine the important issues to look at and also to review the modification proposals. GRS undertook a number of verifications, amongst others its own verification calculations and concluded that the IVR should be possible. A modification application for a retro-fit of an external cooling system for the reactor pressure vessel was filed by the LH and it was implemented in 2017.

Regulatory review and control activities

Apart from the review of the use of proposed codes and standards, the regulatory review activities are mainly related to the scope and programmes of PSRs, licence applications, and modifications without the need for a licence application. Control activities are associated with the inspection of the correct realisation of modifications.

[80] Primary Water Stress Corrosion Cracking, PWSCC

18.3 Design in relation to human factors and man-machine interface

Arrangements and regulatory requirements

NVR-NS-R-1 is currently the basis for the design, as licence condition. A comparable requirement as R32 from SSR2/1 can be found there. The SSR2/1 requirement 5.53 is new and not yet implemented in the regulatory framework of the Netherlands, but this is mainly applicable to a new build reactor. Borssele NPP has more than 50 years of experience in operations and the numbers of people needed. In the NVR-NS-R-1 requirement 5.56, the following additional text was included: “For design purposes it shall be taken that any required operator action is not needed within 30 minutes after the initiating event. A shorter time shall be justified.”

Implementation measures taken by the licence holder

The original plant was designed and constructed around 1970, when the human factor might have played a role, but to a much lesser degree than later on when new insights emerged after TMI and also from ideas implemented in modern designs. The first real PSR-type of exercise started after Chernobyl and led to the large modification programme in the second half of the 1990s. The modification programme undertaken at Borssele included consideration of a whole range of man-machine interface elements (also discussed in the section on Article 12). The most notable elements of the programme included the redesign of the control room, the addition of a backup emergency control room and additional local control capabilities to improve process information and controllability in all plant states, including emergency situations. Other important elements were the redesign of interlocking control processes (i.e. bridging, key-operation, and automatic blocking), tackling communication problems, evaluating and improving the accessibility (in terms of physical access and radiation doses) of systems and components during operational states and in emergency situations, and adding remote controls and indicators for safety-relevant components. As a result of the 2011 ‘stress test’ the improvement of accessibility and operability of systems and components under severe circumstances has been implemented as a measure. For instance more remote operation and remote reading of parameters or availability of easy connectable mobile equipment are important and implemented.

A representative mock-up was used to optimise the design of the control room in terms of human factors. Uninterrupted sightlines, readability, communication, manageability and walking distance optimisation were all studied and the results implemented. Control room staffs were also involved in planning the layout. See Appendix 4 for a more detailed description of man-machine interface aspects at the Borssele NPP.

In addition to the Reactor Protection System (RPS) there is the Engineered Safety Features Actuation System (ESFAS) that is designed such that for all design base accidents no operator action is required during the first 30 minutes after start of the event. An exception is allowed for simple actions with clear criteria after the first 10 minutes. In addition, there is a ‘limitation’ system that initiates corrective actions to prevent activation of the RPS and ESFAS systems. All relevant safety related parameters are shown on a special panel, so that the operator is able to check all important safety parameters at the same time.

The design also ensures that the plant is kept in a controlled safe state during a minimum of 10 hours after an external event, without any operator actions (autarky). The autarky of the power plant has been further improved by the implementation of automatic start of the reserve emergency cooling system and reserve spent fuel pool cooling system if the normal cooling provisions are not available. By this measure the cooling of certain important systems (e.g. diesel generators) and installations (e.g. electronics) and the spent fuel is guaranteed. After the most recent PSR (10EVA13), the time that the plant can be kept in a controlled safe state after an event, without the need for off-site assistance or supply (autonomy) has for external events been expanded from 24 hours to 72 hours minimum, which is equal to that for internal events.

The introduction of the PWR Owners Group (‘PWROG’) system of ERGs, FRGs and SAMGs in the 1990s and the further development of these with the introduction of FSGs and EDMGs, including updates after the Fukushima accident, can also be seen as a mayor improvement for the operators. Some modifications were necessary to adapt the PWROG-approach to the Siemens KWU design.

A newer development in the training of workers is the building of a special building with mock-ups of some parts of the mechanical and electrical installation, where for instance maintenance activities can be simulated.

Regulatory review and control

The regulatory review activities are mainly related to the scope and programmes of PSRs, licence applications and modifications without the need for a licence application. Control activities are associated with the inspection of the correct realisation of modifications. The HF and MMI experts of the ANVS keep informed of relevant developments through for instance the OECD/NEA/WGHOF and also have access to knowledge of the TSO.

Article 19. Operation

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

i. the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

ii. operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

iii. operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

iv. procedures are established for responding to anticipated operational occurrences and to accidents;

v. necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;

vi. incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the Regulatory Body;

vii. programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organisations and regulatory bodies;

viii. the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

The Kingdom of the Netherlands fulfills the obligations of Article 19.

19.1 Initial authorisation to operate: safety analysis and commissioning programme

It should be noted that experience with initial safety analysis and commissioning is limited, as no new nuclear power plants have been built in the Netherlands since 1973. This section is therefore related to comparable experience with:

- Periodic Safety Reviews (PSRs) of the Borssele NPP (see Article 14(i));
- The results of reviews by international team reviews like OSART and;
- Commissioning after significant changes to the installations as a result of a PSR.

As discussed in the section in Article 14, an in-depth safety assessment of the NPP has been made. The commissioning aspects concerning modified structures, systems and components are reviewed once the assessments have been completed.

Pursuant to NVR NS-R-2 (Safety of NPPs: Operation), the LH must set up a 'Commissioning Programme' (CP). Instructions for this task are provided by NVR NS-G-2.9 (Commissioning for NPPs). The CP has to be approved by the inspectorate of the Regulatory Body (RB), which is the ANVS. The ANVS has to assess the

completeness of the programme but some parts are evaluated in detail. The findings are discussed with the Licence Holder (LH) so that necessary changes can be made, after which the programme can be approved.

The inspectors select certain items for closer monitoring during the actual commissioning process. Audits are performed, both by the LH and by the ANVS, where necessary assisted by external experts, to ensure that the CP is being properly executed. They focus on the organisation and quality systems of both the LH and its contractors. Nevertheless, the establishment and performance of an appropriate CP remains the full responsibility of the LH.

After refuelling the reactor including all maintenance activities, the LH must submit to the ANVS the results of all relevant analyses, tests, surveillances and inspections. The ANVS will evaluate this information to establish whether all SCCs important to safety meet the requirements and certain criteria for reliability, before granting a restart. It should be noted that inspectors of the ANVS are present during the activities associated with refuelling and maintenance. If no deviations are found, the power plant management can decide to restart the plant. In the current philosophy of the ANVS, at that stage no prior consent will be given, only if there is an issue the ANVS will formally request not to restart.

The Dutch government in 2006 signed an agreement (covenant) with the owners of the Borssele NPP, which allows for operation until the end of 2033, at the latest, if next to the requirements of the Nuclear Energy Act and the licence conditions specified in the covenant are met. The LH has started a project which should demonstrate that the plant and its organisation are capable of safe operation during its anticipated operating life. This project was amongst others based on guidance provided by IAEA Safety Report Series No. 57 ‘Guidance for Safe Long Term Operation’. The RB initiated a set of SALTO missions (2009-2014), to support its assessments and to make sure that the scope of the LTO-programme was according to international standards.

Currently Borssele NPP is investigating the possibility for a second LTO for operation beyond 60 years. We refer to Appendix 4 for more information on this. In 2024 a pre-SALTO was performed to prepare for a SALTO mission in the coming years.

19.2 Operational limits and conditions

The Borssele NPP licence states that the conditions must be described with which the systems, system components and organisation of the operation of the installation must comply, as well as the measures taken in order to operate the installation in such a way that all requirements described in the licence are satisfied. These conditions shall be approved in advance by the ANVS.

These conditions are described in the Technical Specifications (TS). The basis for these is NVR NS-G-2.2 (Operational Limits and Conditions and Operating Procedures for NPPs), but NUREG 1431 was used as a basis for their revision. The TS include the limits and conditions for operation, allowable outage times and surveillance requirements for SSCs dedicated for the control of design basis accidents.

The scope of the TS is expanded to include also SSCs dedicated for the control of beyond design basis accidents and SSCs dedicated for the mitigation of the consequences of severe accidents. This includes OLCs for permanently installed SSCs as well as mobile equipment.

All deviations from the TS must be reported to the ANVS. The ANVS checks on compliance with the TS during its regular inspections.

According to NVR NS-G-2.2 the plant management has the primary responsibility of ensuring that the operational limits and conditions are complied with. To fulfil this responsibility, relevant checks and control systems have been established. All personnel holding responsibility for the implementation of operational limits and conditions are provided with the latest version of the associated documentation. There are written procedures providing for issuing and control of operational limits and conditions and their approved modifications. The operating organisation conducts audits to verify compliance with the operational limits and conditions.

The quality assurance system of the Borssele NPP requires the conditions for operation and the limits as laid down in the Technical Specifications to be observed at all times. This has priority over the economic

production of electricity. NVR NS-R-2 (Safety of NPPs: Operation) states that plant management has a direct responsibility for the safe operation of the plant. All safety-relevant management functions must be supported at the most senior level of management. In addition, the organisational structure features a special senior manager who is responsible for the independent supervision of nuclear safety, radiation protection and quality assurance at the plant. He may report directly to the CEO at the Borssele site. This ensures that safety is given a proper role in this efficiency oriented production environment.

19.3 Procedures for operation, maintenance, inspection, and testing

The NVR NS-R-2 (Safety of NPPs: Operation) states that operation, maintenance, inspection and testing must take place in accordance with established procedures. Since the NVRs are part of the licence, the LH is bound by these conditions. The plant is operated in accordance with the instructions given in the Operating Manual, which is an extensive document describing all relevant details of plant operation. Specific instructions are given for abnormal conditions, as well as for incidents and accidents (see also the section on Article 19(iv)). These documents are approved by plant management, but are in general not submitted to the ANVS for approval. However, the Technical Specifications, changes in the structure of the EOPs/SAMGs, the code of conduct, the rules and regulations of the internal and the external reactor safety committees of the plant as well as the ISI programme have to be approved by the ANVS.

The establishment of an Internal Reactor Safety Committee (IRSC) and an External Reactor Safety Committee (ERSC) is a licence condition for Borssele NPP and the HFR research reactor. The IRSC is a reviewing body within the plant management structure to evaluate and review all matters important to nuclear safety and radiological protection. The IRSC advises and reports to the plant management and reports also to the ERSC. The ERSC is a committee under responsibility of the operating organisation to provide independent review and surveillance of the functioning of all internal safety control and safety evaluation provisions within the operating organisation such as quality assurance, IRSC, plant management and structure of the operating organisation. In addition, the ERSC may evaluate and review matters important to nuclear safety and radiological protection. The ERSC advises and reports to the operating organisation. The terms of reference, function, authority and composition of both IRSC and ERSC are subject to approval by the ANVS. The Borssele LH has described the utility management processes in relation to functions such as operation, maintenance and testing in more fundamental terms. The emphasis is on the ‘key processes’ of the utility organisation. Each key process describes the kind of essential processes needed, how communication between various groups and departments is to be performed and what kind of instructions and forms must be used.

The system of key processes enhances the utility’s self-assessment capability. The management processes were implemented as a ‘first generation’ quality system in the late eighties and the system was improved in the early nineties to produce an integrated quality management system (in accordance with the IAEA codes and guides) incorporating a process-based approach. The management system comprises all the main processes in the plant: Management & Organisation, Training, Operations, Nuclear Fuel Management, Chemistry, Maintenance, Radiation Protection, Radwaste Treatment, Procurement, Configuration Management, Environmental Management, Industrial Safety, Security, Emergency Planning & Preparedness and Auditing.

The associated management procedures describe not just tasks and responsibilities, but also the input-documents (instructions, periodical programmes, checklists and specifications) to be used and the output-documents (forms and reports) to be generated.
The Operations process covers all activities in the operations field and their interfaces with other processes (like Maintenance, Chemistry and Fuel Management), for example:

- Plant status control, Technical Specifications;
- Work-order process, work licensing procedure;
- (Functional) surveillance testing;
- Surveillance rounds;
- Event procedures, EOPs;

- Event reporting;
- Procedures for taking the plant to shut-down;
- Procedures for start-up of the plant;
- Temporary modifications;
- ODM;
- Justification of continued operation.

The Maintenance process covers all activities in the maintenance field, including interfaces with other processes (like Operations and Procurement), for example:

- Preventative maintenance programmes, ISI programme, calibration & test programmes;
- Ageing management;
- Preparation and execution of maintenance tasks, work-order system;
- Maintenance reporting.

The ANVS checks the use of instructions and forms during its regular inspections. The quality assurance system for each key process is verified during audits (carried out by the LH, the ANVS or a third party). As already stated in the text on Article 13, the quality assurance system complies with NVR-GS-R-3.

According to NVR NS-R-2 (Safety of NPPs: Operation), any non-routine operation which can be planned in advance and any test or experiment will be conducted in accordance with a prescribed procedure to be prepared, reviewed and issued in accordance with established procedures in order to ensure that no operational limit and condition is violated and no unsafe condition arises. However, should this operation nevertheless lead to an unexpected violation of one or more operational limits and conditions, standing orders shall instruct the personnel supervising or operating the controls of the plant to comply with the operational limits and conditions and consequently to bring the plant back into a safe condition. It shall be demonstrated that there is a definite need for the test or experiment and that there is no other reasonable way to obtain the required information.

Programmes and procedures for maintenance, testing, surveillance and inspection of structures, systems and components important to safety have been prepared and implemented, as a result of Periodic Safety Reviews as mentioned in Article 14.

19.4 Procedures for response to AOOs and accidents

Licence Holders have to satisfy the requirements of NVR GS-G-2.1 (Requirements for operation) and NVR-NS-G-2.15 (Accident Management).

The Borssele NPP has developed a comprehensive set of procedures to enable it to respond to anticipated operational occurrences (AOOs) and accidents. Deviations and simpler malfunctions are the subject of Alarm cards and Abnormal Operating Procedures. Emergency situations are dealt with by symptom-based Emergency Operating Procedures (EOPs). Severe Accident Management Guidelines (SAMGs) have been introduced. These are intended to provide guidance on accidents involving core damage and potential radioactive discharges into the environment.

The Borssele NPP LH follows the approach adopted by the PWROG, both for EOPs, SAMGs and the latest set of FSGs. The severe accident management guidance defines priorities for operator actions during the various stages of a core melt process, sets priorities for equipment repairs and establishes adequate lines of command and control. Care has been taken to tailor the PWROG approach to the particular characteristics of this Siemens/KWU station. The LH has extended the existing EOPs and SAMGs with non-power procedures not available in the generic WOG package. A new set of generic procedures was introduced by PWROG to guide the use of mobile equipment. These procedures called FSGs (FLEX Support Guidelines) can be used in addition to the EOPs and SAMGs. The Borssele NPP also made the FSGs plant-specific. The FSPs are referenced in all applicable steps in the EOPs and SAMGs of the Borssele NPP.

Both operators and other staff are given frequent training in the use of emergency operating procedures. This takes the form of courses on the full-scope simulator, and emergency exercises at the plant. A data link for the process computer has been created between the plant and the simulator to enable calculating real time accident progression data in the phases before core melt to be monitored during an exercise by the staff at the plant. This simulator process data can also be transferred in real time to the ANVS in The Hague and to the severe accident support centres of Framatome. It is also possible to transfer the process data of the plant itself through these data links to the ANVS and to Framatome.

In the event of a severe accident, support is also available from the plant vendor, which operates a round-the-clock service to assist affected plants and is available on call.

The supervision of safety relevant changes of important operating procedures by the ANVS will be further improved starting with the procedures that will be developed or changed based on the lessons learned from Fukushima.

19.5 Engineering and technical support

The Borssele NPP LH has built up considerable expertise and is able to manage most safety-related activities. The staff is suitably qualified and experienced as stated in Article 11.2. In addition, the LH works in close collaboration with the plant vendor and other qualified organisations in the Netherlands and abroad. Among the companies and institutions contracted are the VGB, Framatome, NRG, Engie, PWR owners group and AVN.

Procedures have been developed and implemented for contractors. For instance, contractors are made familiar with the installation and normal working procedures by showing them training films explaining ‘work practices’.

The supervision of the ANVS on the subject of qualification of technical support organisations for the LH has been limited mainly to the contractors acting on site during refuelling or modifications.

The ANVS frequently uses TSO support for its assessments and inspections. For more information on the organisation of contracted support for the ANVS, refer to the text on Article 8 ‘Regulatory Body’.

The ANVS also benefits from input from the EU Clearinghouse for the evaluation of incidents. One of the predecessors of the ANVS is one of the founding partners of the EU Clearinghouse.

To date the Borssele NPP has always been able to contract services supporting its maintenance and modification programs; the ANVS has also initiated an international cooperation between regulators overseeing the activities of operators with Siemens/KWU reactor designs, the KWUREG group. This is especially relevant considering the German phase-out of nuclear power.

For current staffing at the RB, refer to the text on Article 8.

19.6 Reporting of incidents

An incident-reporting system is a condition of the licence and is in operation for all existing nuclear installations. The system is based on NVR NS-G-2.11, ‘A System for the Feedback of Experience from Events in Nuclear Installations’. Furthermore, the ANVS has published a guideline for licencees on reporting incidents, detailing who is responsible for reporting these events, how and at within how many hours or days they must be reported, and the requirements for written reports.

The criteria for reporting to the regulatory authorities are described in the Technical Specifications. Depending on its nature, an event must be reported to the ANVS:

- Category I events have to be reported by telephone immediately and within 14 days by letter.
- Category II events have to be reported within eight hours by telephone and within 14 days by letter.
- Category III events have to be reported within 30 days by letter.

Examples of category I events are:

- Plant condition ‘Emergency standby’ or worse.

- Exceedance of 10 times dose year limit.
- Loss of high active source.

Examples of category II events are:

- Violations of the licence and the Technical Specifications limits, exposure to high doses (as referred to in the Bkse), activation of the reactor protection system leading to reactor scram, ECCS actuation and/or start of the emergency power supply (diesel generators).

Examples of category III events are:

- (Minor) leakages of fuel elements, leakage of steam generator tubes and of the primary system, non-spurious activation of the reactor protection system and events causing plant staff to receive a dose in excess of 10 mSv.
- Degradation of safety systems or components, and events induced by human activities or natural causes that could affect the safe operation of the plant.

In exceptional situations, i.e. if there is a major release of radioactive material or if a specified accident occurs (> 2 on the International Nuclear Event Scale, INES), the NPP is obliged to notify the National Emergency Centre directly. Depending on the nature of the accident, various government bodies are alerted. The ANVS is always alerted. Further information is given in the section on Article 16.

The ANVS houses the national officer for INES (International Nuclear Event Scale) and also the national coordinator IRS (Incident Reporting System) and IRSRR (Incident Reporting System for Research Reactors). Furthermore the ANVS is responsible for the newer systems like FINAS and the NEA system for the collection of events during construction of a new nuclear installation.

Reports from the LH are first handled by the ANVS inspector on duty. The inspector prepares, if necessary supported by colleagues, a first action or reaction to the LH. Next the ANVS experts work further on the report and take the suitable actions like requiring further action from the LH, international reporting and determining the INES scaling. The ANVS prepares an annual report on nuclear incidents to the Dutch Parliament and monitors the progress made by the LHs on the follow-up of incidents.

19.7 Sharing of important experience

Nuclear Power Plant (Borssele)

A standing task force at the nuclear power plant assesses incidents. The establishment of this task force is required under the licence. A second standing task force assesses ageing issues. It is recognised that the effects of ageing may pose technical challenges in the future, and that expertise and adequate data on operational history need to be available to cope with these potential problems. The LH of the NPP operates databases for its own use and these contain data on incidents from various sources, including the plant itself, WANO, IAEA and OECD/NEA IRS, IAEA News, VGB, Framatome, US NRC, GRS, etc.

Borssele reports relevant incidents to WANO and VGB. Operational measures obtained from WANO (Good Practices and Performance Objectives & Criteria) are implemented by Borssele NPP.

Information is regularly exchanged on a bilateral basis with operators in neighbouring countries, plus a number of other countries. Personnel of Borssele actively participates in WANO-, OSART-, AMAT- and other missions at foreign NPPs.

Research reactors and fuel cycle facilities (uranium enrichment and nuclear waste storage)

These facilities have organisational structures and expertise to share important experience between facilities. All of them have standing task forces for the assessment of incidents.

All facilities have specific international contacts within their scope of work.

The Regulatory Body

There are contacts with regulatory bodies of many European countries, Australia, South Africa, Canada, USA and South Korea. Within the framework of the NEA, the Netherlands participates in a working group

dealing on a regular basis with operational events. The Netherlands are a member of the OECD/NEA and IAEA mechanisms for sharing key operational experience, the Working Group on Operational Experience (WGOE) of the OECD/NEA Committee for the Safety of Nuclear Installations (CSNI), and the international incident reporting systems (IAEA and OECD/NEA IRS, IRSRR and FINAS). Further the Netherlands are a member of the EU Clearing House. Since 2013 the ANVS has close relations with RBs in countries that like Germany have one or more operating Siemens/KWU plants (KWUREG club): Argentina, Brazil, Switzerland and Spain.

According to a 2014 IRRS recommendation the ANVS has to improve the OEF and REF to make a more structured approach according to international standards. In 2015 the ANVS collected a lot of information about OEF practices in other countries, including hosting an IAEA Workshop end of 2015. In 2016 a project started to implement the recommendations. In 2018 during the IRRS FU mission the ANVS presented its approach and some examples. IAEA was satisfied with the results and closed the recommendations with confidence that they will be implemented.

Satisfying the requirements stemming from a modification of the Nuclear Energy Act and article 17 of the Ministerial Regulation on Nuclear Safety for Nuclear Installations, the ANVS has intensified the reporting and informing about incidents in neighbouring countries.

For several years, the ANVS has contributed to a OECD/NEA database 'FIRE' of the 'Fire Incidents Records Exchange' project. Since 2017 the ANVS is also contributing to two other OECD/NEA databases projects, which collect specific incident data for analysis: International Common-cause Failure Data Exchange (ICDE) and Component Operational Experience, Degradation and Ageing Programme (CODAP).

19.8 Generation and storage of radioactive waste

The licence for the NPP states that the provisions of the NVRs must be satisfied. On the issue of radioactive waste management, NVR NS-R-1 (Safety of NPPs: Design) requires adequate systems to be in place for handling radioactive solid or concentrated waste and for storing this for a reasonable period of time on the site. The LH has such systems at its disposal and keeps records of all radioactive waste materials, specifying the type of material and the form of packaging.

The Dodewaard NPP has sent all fuel for reprocessing at Sellafield and has sent all easy removable waste to COVRA. The plant has been transformed into a safe enclosure. This building will contain the remaining materials for 40 years (until 2046) in order to minimise both the activity and the volume of the waste eventually to be transported to COVRA.

The LH of the Borssele NPP has adopted a written policy of keeping the generation of radioactive waste to the minimum practicable. One of the measures taken to this end is ensuring that the chemistry of the primary system is adequate, in order to reduce the generation of corrosion particles which may be activated. Internal procedures are used to achieve optimum water quality.

Solid waste from the site is transported in accordance with conditions set by the RB. Under these conditions, the LHs have to draw up a timetable for the transportation of radioactive waste to the COVRA interim storage facility for all radioactive waste produced in the Netherlands. The LHs must send a list to the ANVS at the beginning of each year, stating how much radioactive waste is in storage on-site and how much waste has been transported to COVRA over the previous year.

The NPP's waste management programmes stipulate that general internal radiation protection procedures must be observed so as to satisfy the radiation protection principles, as well as NVR NS-G-2.7 (Radiation Protection and Radioactive Waste Management in the Operation of NPPs). The latter includes the treatment and storage of spent fuel and waste directly related to operation (taking conditioning and disposal into account). The ANVS is informed, as described in the section on Article 15.1.

Spent fuel from the Borssele NPP is reprocessed at Orano in La Hague (France) and the resulting waste components and the vitrified waste are stored at COVRA. Borssele recycles its Plutonium through the use of MOX-fuel.

Appendix 1 Safety Policy and Safety objectives in the Netherlands

1.1 Safety objectives in a historical perspective

In the Netherlands, safety policy in the nuclear field was originally based on the following overarching fundamental safety objectives of IAEA Safety Series No. 110[81] of 1993:

The general nuclear safety objective:

"To protect individuals, society and the environment from harm by establishing and maintaining in nuclear installations effective defences against radiological hazards."

The general nuclear safety objective is supported by two complementary safety objectives:

The technical safety objective:

"To take all reasonably practicable measures to prevent accidents in nuclear installations and to mitigate their consequences should they occur; to ensure with a high level of confidence that, for all possible accidents taken into account in the design of the installation, including those of very low probability, any radiological consequences would be minor and below prescribed limits; and to ensure that the likelihood of accidents with serious radiological consequences is extremely low."

The radiological safety objective:

"To ensure that in all operational states radiation exposure within the installation or due to any planned release of radioactive material from the installation is kept below prescribed limits and as low as reasonably achievable, and to ensure mitigation of the radiological consequences of any accidents."

Later on, Safety Series No 110 was superseded by IAEA SF-1, 'Fundamental Safety Principles' of the IAEA Safety Standards Series. There is no principal difference between the 'fundamental safety objective' in SF-1 with the above objectives of SS No 110.

SF-1: Ten fundamental IAEA safety principles

As discussed in the sections on the various articles of the Convention, extensive rules and regulations, derived from the IAEA Safety Standards, have been defined and formally established. No licence is issued unless the applicant satisfies the regulations. Inspections are carried out to monitor compliance with the rules. Priority is given to safety, and the Licence Holder (LH) is aware of its responsibility for safety. Periodical Safety Reviews (PSRs) are conducted, to ensure that new safety insights are taken into account.

The ANVS therefore believes that all echelons of the defence-in-depth principle have been preserved, so that there is a low probability of accidents and, should accidents occur, the probability of radiological releases is very low. Even in the case of accidents beyond the design basis – those that might lead to serious radiological releases – measures have been taken to further reduce their probability and to mitigate the consequences should they occur. The follow-up of the 'stress test' included measures that have further increased the safety margins.

The fundamental safety principles of the IAEA SF-1 are outlined on the next page. In each case there is a brief description of the principle and of how that principle was developed in the Dutch context, in terms of policy and strategy for nuclear safety and radiation protection.

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[81] 'The Safety of Nuclear Installations – Safety Fundamentals', Safety Series No 110, IAEA, 1993

Table 4 Fundamental Safety Principles policy and strategy

No		Principle	Contents
1		Responsibility for safety	The prime responsibility for safety must rest with the person or organisation responsible for facilities and activities that give rise to radiation risks. • Licensing system linked to a specific individual Personal responsibility and a justified confidence (that can be substantiated) with regard to operations (including safety culture, expertise), technology (including safety reports), and financial means (providing security) A system of licences and registrations, and the associated supervision and enforcement
2		Role of government	An independent administrative body, must be established and sustained. • Nuclear Energy Act as an integral legal framework • The ANVS as an independent administrative body
3		Leadership and management for safety	Effective leadership and management for safety must be established and sustained in organisations concerned with, and facilities and activities that give rise to, radiation risks. • Guarantees through regulation based on general rules, licensing, and supervision
4		Justification of facilities and practices	Practices that involve exposure to ionising radiation are only permitted if the economic, social and other advantages of the practices in question outweigh the health detriment they can cause. • Assessment of generic and specific justification is anchored in legislation and licensing
5		Optimisation of protection	Protection must be optimised to provide the highest level of safety that can reasonably be achieved. • Optimisation principle and/or ALARA principle • Continuous improvement
6		Limitation of risks to individuals	Measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm. • Dose limitation in legislation and licences

7		Protection of present and future generations	People and the environment must be protected against radiation risks, now and in the future. • Central goal of the Nuclear Energy Act and the legislation based on it • Licences and requirements for termination and decommissioning • Radioactive waste policy (including geological disposal) • Financial provisions for decommissioning, dismantling and geological repository
8		Prevention of accidents	• All practical efforts must be made to prevent and mitigate nuclear or radiation accidents • Strict general rules and the associated licensing policy • Preventive assessment of applicants (in terms of expertise, reliability and solvency) • Regulatory and intervention policy; compliance with requirements
9		Emergency preparedness and response	Arrangements must be made for emergency preparedness and response for nuclear or radiation incidents. • Crisis policy and emergency response organisation • Licencee requirements (including company contingency plan and expertise requirements) • Coordination with neighbouring countries • Information provision and communication
10		Protective actions to reduce existing or unregulated radiation risks	Protective actions to reduce existing or unregulated radiation risks must be justified and optimised. • Legislation concerning natural sources and orphan sources • Detecting unregulated sources • Information provision • List of existing radiation risk situations • Radon action plan

1.2 Dutch environmental risk policy

The concept of risk management and risk assessment was first introduced into Dutch environmental policy in the 1986-1990 Long-Term Programme for Environmental Management. The concept was reassessed following debates in Parliament. As part of the Dutch National Environmental Policy Plan[82], the government set out a revised risk management policy in a document called 'Premises for Risk Management; Risk Limits in the Context of Environmental Policy'[83]. Next, a separate document was issued dealing with the risk associated with radiation: 'Radiation Protection and Risk Management; Dutch Policy on the Protection of the Public and Workers against Ionising Radiation'[84]. These documents still constitute the basis for government policy on risk management.

The Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) has been amended to incorporate this risk policy in the licensing process for nuclear installations.

Risk criteria are explicitly included as assessment principles for licences to be granted to nuclear power plants. The outcomes of a level-3 PSA must be compared with these risk criteria and objectives.

This concept of environmental risk management incorporates the following objectives and steps:

- Verifying that pre-set criteria and objectives for individual and societal risk have been met. This includes identifying, quantifying and assessing the risk;
- Reducing the risk, where feasible, until an optimum level is reached (i.e. based on the ALARA principle);
- Maintaining the risk at this optimum level.

Normal operation

The dose limit due to normal operation of installations consists of a maximum total individual dose of 1 mSv in any given year for the consequences of all anthropogenic sources of ionising radiation (i.e. NPPs, isotope laboratories, sealed sources, X-ray machines, etc.). For a single source, the maximum individual dose has been set at 0.1 mSv per annum. In addition, as a first step in the ALARA process, a general dose constraint for any single source has been prescribed at 0.04 mSv per annum.

Design-basis accidents

Design-basis accidents (DBAs) are postulated to encompass a whole range of related possible initiating events that can challenge the plant in a similar way. These individual related initiating events do not therefore need to be analysed separately.

With DBAs it is easy to introduce the required conservatism. With a probabilistic approach, uncertainty analyses need to be performed to calculate confidence levels.

By definition, DBAs are events that are controlled successfully by the engineered safety features. Hence, they do not result in core melt scenarios, and are considered in a PSA as being 'success sequences'. The related radioactive releases are negligible compared with the uncontrolled large releases associated with some of the beyond-design-basis accidents. In other words, a general 'state-of-the-art' PSA, which focuses primarily on core melt scenarios and associated large off-site releases, does not take account of the consequences of DBAs.

Clearly, the above dose and risk criteria are not suitable for use as rigid criteria in the conservative and deterministic approach used in traditional accident analyses. A separate set of safety criteria has therefore been formulated, as required by NVR NS-R-1[85]. The set of criteria is defined in the Nuclear

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[82] Lower House of the States General, 1988-1989 session, 21137, Nos. 1-2, The Hague 1989

[83] Lower House of the States General, 1988-1989 session, 21137, No. 5, The Hague 1989

[84] Lower House of the States General, 1989-1990 session, 21483, No. 1, The Hague 1990

[85] NVR NS-R-1 'Veiligheid van kernenergiecentrales: veiligheidseisen voor het ontwerp', which is an adaptation of IAEA Safety Requirements Safety Standard Series No. NS-R-1, 'Safety of Nuclear Power Plants: Design Safety Requirements'

Installations, Fissionable Materials and Ores Decree (Bkse, refer to text on Article 7 of the CNS). The criteria are:

Table 5 Safety criteria coupled to DBAs

Frequency F of event per annum	Effective dose (H_{eff}, 50 years) in mSv	
	Adult	***Child***
$F \geq 10^{-1}$	0.1	0.04
$10^{-1} > F \geq 10^{-2}$	1	0.4
$10^{-2} > F \geq 10^{-4}$	10	4
$F < 10^{-4}$	100	40

An additional limit of 500 mSv thyroid dose (H_{th}) must be observed in all cases.

Correspondingly the provisions concerning the dose related to normal operation as a first step in the ALARA process, a general dose constraint has been prescribed at values of 40% of the above mentioned.

Severe accidents

As far as severe accidents are concerned, both the individual mortality risk and the group risk (= societal risk) must be taken into account.

The maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per annum for all sources together and 10^{-6} per annum for a single source.

In order to avoid large-scale disruptions to society, the probability of an accident in which at least 10 people suffer acute death is restricted to a level of 10^{-5} per annum. If the number of fatalities increases by a factor of n, the probability should decrease by a factor of n^2. Acute death means death within a few weeks; long-term effects are not included in the group risk.

To demonstrate compliance with the risk criteria direct measures such as evacuation, iodine prophylaxis and sheltering are not taken into account.

This risk management concept is used in licensing procedures for nuclear installations.

For NPPs the level-3 PSA plays an important role in the verification process. Specific procedural guidelines have therefore been drafted in the Netherlands for the conduct of full-scope PSAs. The level-1 PSA guide is an amended version of the IAEA SSG-3 'Development and Application of Level 1 Probabilistic Safety Assessment for NPPs' and the level-2 guide is based on IAEA SSG-4 'Development and Application of Level 2 Probabilistic Safety Assessment for NPPs'.

The procedural guide for level-3 PSAs is a specifically Dutch initiative, in which the COSYMA code for atmospheric dispersion and deposition is used. It gives instructions on the pathways which have to be considered, the individuals (i.e. critical groups) for whom the risks should be assessed and the type of calculations which should be performed. It also describes how the results should be presented.

Since it has been recognised that PSAs produce figures that can be used as a yardstick in safety decisions, a number of countries have developed probabilistic safety criteria. The ANVS has taken note of the INSAG-3 safety objective, i.e. the maximum acceptable frequency for core damage currently is 10^{-5} per annum for new NPPs and 10^{-4} per annum for existing NPPs. In the meantime in the Netherlands these values have evolved to lower values.

In addition, the objective of accident management strategies should be that the majority of potential accident releases will not require any immediate off-site action, such as sheltering, iodine prophylaxis or evacuation. This means that the dose to which members of the public are exposed in the first 48 hours after the start of the release should not exceed 10 mSv. The PSA helps to employ measures as effectively as possible.

1.3 Continuous improvement

The Netherlands has brought Council Directive 2009/71/EURATOM of 25 June 2009 and Directive 2014/87/EURATOM establishing a Community framework for the nuclear safety of nuclear installations on nuclear safety into force[86]. The safety objectives of the Directives cover those of the Convention on Nuclear Safety and are in some regards more specific and have a larger scope. The regulation asks for the continuous improvement of safety.

The Directives refer to amongst others to IAEA SF-1 for its appropriate implementation by the EU member states. The Netherlands thus formally complies with the principles of SF-1.

All parties involved in nuclear safety and radiation protection (LHs and RB) must make every effort to achieve continuous improvement. The aim is to ensure the safety and protection of people and the environment as effectively and efficiently as possible, while conforming to the state-of-the-art. To this end, policymakers have closely examined similar situations in other countries. This requires that both the government and the companies involved use management systems that are capable of continuous testing and evaluation. The government imposes national and international testing and evaluation requirements on the sector.

1.4 Guidelines on the safe design and operation of nuclear reactors

In October 2015 the ANVS published the VOBK[87] , the Guidelines on the Safe Design and Operation of Nuclear Reactors - Safety Guidelines for short. These Guidelines provide new (light water) reactor licence applicants with detailed insight into what the ANVS considers to be the best available technology. Currently, the VOBK is being revised.

It consists of an (extensive) introductory part and a technical part, the 'Dutch Safety Requirements', the DSR. Refer to the text on Article 7 for more details on the VOBK. The VOBK is non-binding as such – so at the same level as the NVRs and IAEA standards. An incentive for its development were earlier plans for nuclear new build. The DSR provides for clear requirements for up-to-date requirements for NPPs and research reactors, in line with a graded approach, covering the lifetime of the plant.

The DSR focusses mainly on technical requirements.

The DSR are based on the latest insights regarding the safety of new nuclear reactors. Specifically, the latest design and operating recommendations made by the IAEA and the WENRA have been incorporated. The Finnish regulations were also referred to in connection with various matters in the field of new facility construction. Finally, the IAEA lessons learned from the Fukushima accident are reflected in the DSR.

The IAEA recommendations are derived from various documents, such as SF-1 Fundamental Safety Principles, Specific Safety Requirements 2/1 and 2/2, NS-R-3 Site Evaluation for Nuclear Facilities and NS-R-4 Safety of Research Reactors. The lessons learned from the Fukushima accident are identified in the IAEA's document DS 462, which were incorporated in revised versions of 5 IAEA Requirements documents.

Those lessons include the need for improved readiness for natural disasters. The DSR now require licence applicants to take explicit account of possible combinations of natural disasters and the impact of natural disasters, both on the safety systems within the facility itself and on the surrounding infrastructure. In addition, the possibility of 'cliff-edge effects' and the scope for building greater safety margins into the design shall be investigated.

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[86] 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)

[87] Dutch: Veilig Ontwerp en het veilig Bedrijven van Kernreactoren, VOBK

The technical requirements part of the DSR has seven main chapters and six annexes. The most important chapters of the technical DSR are the chapters 2 and 3. The structure and content of the DSR is explained below to some detail.

Ch 1 Fundamental principles

The fundamental safety objective is to protect people and the environment from harmful effects of ionising radiation throughout the entire lifetime of a nuclear reactor: design, construction, commissioning, operation, decommissioning, and dismantling. Safety measures, security measures and measures for accounting for, and control of, nuclear material shall be designed and implemented in an integrated manner in such a way that they do not compromise one another.

Ch 2 Technical safety concept

The safety objectives for new power reactors recommended by the Western European Nuclear Regulators Association (WENRA) have been implemented in the technical safety concept. Also some preliminary lessons learned after Fukushima have been incorporated; future lessons will be incorporated in succeeding updates. Chapter 2 of the DSR addresses five main topics:

Concept of 'Defence in Depth' (DiD), with levels of defence 1, 2, 3a, 3b, 4 and 5. The levels of defence shall be independent as far as practicable.

Concept of multi-level confinement of radioactive inventory, with barriers and retention functions and their links to the various levels of defence.

Concept of fundamental safety functions; reactivity control, core cooling and confinement of radioactive materials. For all levels of defence, the DSR describes the requirements that need to be fulfilled in relation to these safety functions – where applicable.

Concept of Protection against internal and external events. There shall be no failure of safety systems due to external events. With internal hazards, only the affected systems are allowed to fail. Combinations of hazards shall be taken into account.

Radiological safety objectives that have to be complied with. The DSR requires that large releases shall be practically eliminated. Only limited (in area and time) protective measures shall be needed at DiD level 4.

Implementation of the technical safety concept results in practical elimination of phenomena leading to large and early releases (level of defence 4).

Ch 3 Technical requirements

Chapter 3 of the DSR details the technical requirements that when fulfilled will contribute to implementing technical safety concept of chapter 2 of the DSR. Chapter 3 lists many requirements for among others design of the reactor core and shut down systems, fuel cooling in the core, reactor coolant pressure boundary, buildings, containment system, I&C, control rooms etcetera.

Various requirements have been stepped up in comparison to current requirements, like those for redundancy.

Ch 4 Postulated operating conditions and events

A plant specific list of events has to be created. Chapter 4 of the DSR outlines what kind of events need to be considered in relation to the various DiD levels. It also addresses events involving multiple failure of safety installations. In chapter 4 of the DSR, also reference is made to the annex-1 of the DSR with postulated events that as a minimum need to be considered.

Ch 5 Requirements for the safety demonstration

Chapter 5 of the DSR details the requirements for the 'safety demonstration' (safety case). The safety case, to be documented in a Safety Analysis Report (SAR) shall cover all phases during the lifetime of the plant. Reference is made to IAEA Safety Standards for specifications for the SAR. Deterministic as well as probabilistic analysis (including level-3) are required for the safety case.

Ch 6 Requirements for the operating rules

Chapter 6 of the DSR details what kind of information shall be documented for the operating rules. More specific specifications are given in annex-4 of the DSR. The DSR also details requirements regarding accessibility of documentation, updating of documents and associated procedures.

Ch 7 Requirements for the documentation

This chapter states that "*The licencee shall have available a systematic, complete, qualified and up-to-date documentation of the condition of the nuclear power plant*.". For details the DSR refers to its annex-4.

The technical safety concept in the DSR is based on WENRA guidance.

Figure 6 Technical safety concept in DSR, based on WENRA guidance

Levels of defence in depth	Associated plant condition categories	Objective	Essential means	Radiological consequences
Level 1	Normal operation	Prevention of abnormal operation and failures	Conservative design and high quality in construction and operation, control of main plant parameters inside defined limits	Regulatory operating limits for discharge
Level 2	Anticipated operational occurrences	Control of abnormal operation and failures	Control and limiting systems and other surveillance features	
Level 3[1]	Level 3.a Postulated single initiating events	Control of accident to limit radiological releases and prevent escalation to core melt conditions[2]	Reactor protection system, safety systems, accident procedures	No off-site radiological impact or only minor radiological impact
	Level 3.b Postulated multiple failure events		Additional safety features, accident procedures	
Level 4	Postulated core melt accidents (short and long term)	Control of accidents with core melt to limit off-site releases	Complementary safety features to mitigate core melt, Management of accidents with core melt (severe accidents)	Limited protective measures in area and time
Level 5	-	Mitigation of radiological consequences of significant releases of radioactive material	Off-site emergency response Intervention levels	Off-site radiological impact necessitating protective measures

The DSR has six annexes, of which annex-6 is dedicated to requirements for Research Reactors:

Annex 1: Postulated events

This annex to the DSR defines events assigned to the levels of defence in depth. It presents generic event lists for pressurized water reactors (PWRs) and boiling water reactors (BWRs), as well as for spent fuel pools. Especially for these events it shall be demonstrated in accordance with the "Annex 4: Requirements for the safety demonstration and documentation" that the safety-related acceptance targets and acceptance criteria applicable on the different levels of defence in depth are achieved and maintained.

Annex 2: Requirements for provisions and protection against hazards

This annex to the DSR-document, provides additional requirements to the design in providing protection against internal and external hazards.

Annex 3: Basic principles of the application of the single failure criterion and for maintenance

This annex to the DSR document provides requirements regarding the application of the single failure concept and requirements for maintenance. Notable requirements are:

(n+1) for I&C on level of defence 2;

(n+2) level of defence 3a;

(n+1) for active parts on level of defence 3b and 4 according to WENRA / RHWG.

Annex 4: Requirements on the safety demonstration and documentation

This annex to the DSR-document, provides additional requirements regarding the safety demonstration and associated documentation.

Annex 5: Definitions

Annex 6: Requirements for research reactors

Annex 6 provides guidance for the appropriate application of the DSR to research reactors:

Description of the systematic approach of the method.

Matrix of all requirements of the 'Safety Requirements for Nuclear Reactors' and proposal of appropriate application.

Each research reactor is unique and will have to be individually regulated. The annex present a systematic approach to categorization of the research reactor according to the specific hazard potential.

Also a generic event list for research reactors is presented.

Appendix 2 The Role of PSAs in Assessing Safety

2.1 History of the role of PSAs and their role in the Netherlands

As long as a PSA is comprehensive in its scope (including shut-down states, internal and external events, etc.) and is state-of-the-art, it will be an instrument that can be used to roughly demonstrate compliance with safety criteria, thereby recognising the uncertainty and imponderability of a large number of relevant matters. In that way it can be used as a decision-making tool, without the need for an absolute belief in the numbers yielded.

Dutch nuclear power plants (NPPs) launched their PSA programmes in 1989. The main objective was to identify and assess relatively weak points in the design and operation of the power plants, and thus to facilitate the design of accident management measures and to support backfitting. An assessment of source terms, public health risks, etc., was regarded as unnecessary at that time.

Major modification and backfitting programmes were announced at around the same time, partly as a result of the accident at Chernobyl. A backfitting requirement or 'rule' was formulated for the existing NPPs. The requirement addresses the design-basis area, but also the beyond-design-basis area and associated severe accident issues. The 'backfitting rule' also requires 10-yearly safety reviews. This requirement was included in the operating licences issued for both plants. At that time an important part of these 10-yearly safety reviews was a level-1 'plus' PSA (level 1+).

In the early 1990s, these level-1+ PSAs were expanded to full-scope level-3 PSAs, including internal and external events, power and non-power plant operating states, and human errors of omission and commission. The PSAs were expanded partly in order to comply with the requirement that the studies should be 'state-of-the-art' (i.e. including non-power plant operating states and human errors of commission), and partly because of the licensing requirements associated with the ongoing modification programmes (i.e. an environmental impact assessment had to include a level-3 PSA).

2.2 Guidance for and review of the PSAs

At the start of the Dutch PSA programmes in 1988/1989, there were no national PSA guidelines. In addition, both the Licence Holders (LHs) and the Regulatory Body had very little experience in developing a complete PSA for a nuclear power plant. For this reason, the LHs of the NPPs then in operation (Borssele and Dodewaard NPPs) asked foreign contractors to develop their PSAs and at the same time transfer knowledge. Mainly regulatory guidance from the USA was used at that time. The development was further accompanied by a series of IAEA missions. In the early 1990s, in a combined effort, Dutch institutes produced PSA-3 guidelines.

Since the shutdown of the Dodewaard NPP in 1997, the only NPP in operation is the Borssele NPP.

These guidelines were updated in the light of amongst others developments in national regulations (e.g. DSR), dispersion models and dose calculation methods. The update and the supporting studies were completed in 2017. For instance attention was given to lift off of the plume and the influence of buildings. The overall conclusion is that more insights have been gained, although the existing methods are still good enough. The updated guidelines will not result in significant changes in the way PSA-3 calculations are performed in the Netherlands.

2.3 Living PSA applications

After the PSA of Borssele NPP relating to the 1994 modification project had been completed, the focus shifted towards Living PSA (LPSA) applications. The licence of 1994 for the modified Borssele plant required the LH to have an operational Living PSA.

Currently, the PSA for the Borssele NPP is updated yearly. This means that both plant modifications and updated failure data are included in the PSA model. The operator, EPZ, is using the Living PSA for many applications:

- Evaluation of modification proposals (design review);
- Licensing support;
- Technical Specification optimisation (pilot);
- Optimisation of the maintenance programme;
- Optimisation of periodic testing and surveillance;
- Shut-down period configuration evaluation and optimisation;
- Day-to-day configuration evaluation and optimisation;
- Event analysis;
- Development of Severe Accident Management Guidelines (SAMGs);
- Use of PSA source terms for emergency planning & preparedness.

Below a number of the applications are explained to some detail.

Evaluation of modification proposals (design review)

In 1993 the first 10-yearly Periodic Safety Review (PSR) took place. The PSR resulted in a major modification programme. Although the PSA was not yet finalised, it was felt that the PSA could play a large role in the optimisation and evaluation of the deterministic safety concept, the study of alternative solutions and in the licence renewal (Environmental Impact Assessment).

The established modifications reduced the TCDF from 5.6 10^{-5}/year to 2.8 10^{-6}/year.

In 2003 the second PSR took place. The PSA played an important role in this PSR. All issues were weighed against deterministic criteria (Low, Medium and High impact) and the risk significance (TCDF and Individual Risk (IR)).

Technical Specification optimisation

Borssele NPP conducted a pilot to optimise the Allowed Outage Times (AOTs) and inspection intervals. US-NRC Regulatory Guide 1.177 was used as the base for the application, amended to reflect the situation in the Netherlands. The Borssele NPP has modified the acceptance criteria from this guide by lowering them with a factor of 10.

Other boundary values that have been used in the application include:

- For optimisation of AOTs the LH has adopted a value of 5.10^{-8} for ΔTCDF x AOT;
- TCDF shall always < 1. 10^{-4}/year.

Apart from the PSA an expert team participated in the project to address deterministic views, like preservation of defence in depth and safety margins. The team also took into account items like necessary maintenance and repair times, adequacy of spare parts, availability and duration of supply of components on the market.

Shut-down period configuration optimisation (use of risk monitor)

One of the main objectives for the use of the risk monitor for configuration control is to minimise the TCDF increase as a result from planned component outages by for example:

- Mastering simultaneous component outages.
- Rescheduling component outages with high TCDF impact in a certain plant operating state to an operating state where the component outage has a lower impact.

As a decision yardstick several numerical criteria are used by the LH:

- Cumulative TCDF increase caused by planned and planned and unplanned component outages combined – target values for these are set each year by EPZ management;
- Instantaneous TCDF shall never exceed the value of 1. 10^{-4} / year.

Day-to-day configuration evaluation

LPSA is used for the day-to-day evaluation of the configuration. The Borssele NPP is equipped with a high redundancy level. In many cases where a component is taken out of service, the technical specification AOT is not entered. In this area, the use of LPSA is very useful. The cumulative delta-TCDF is used as a special performance indicator for this. Each year, EPZ management sets targets for this, related to scheduled maintenance (planned outages) and for planned and unplanned outages combined.

Development of Severe Accident Management Guidelines (SAMGs)

The level-2 PSA demonstrated that SGTR events with a dry secondary side of the SG could cause the largest source terms and thereby, be a large contributor to the public health risk (Source Terms up to 50% Cs and I). The most promising strategy was the scrubbing of the source term through the water inventory in the SGs. By installing extra pathways to keep the SGs filled with water (including flexible hose connection with the fire-fighting system) a factor 14 reduction in the magnitude of the source term (CsI and CsOH) could be achieved. A closer look at the MAAP4 results showed that the major effect was not the scrubbing effect, but by deposition of fission products on the primary side of the SG tubes. This deposition effect plays also a large role in other core melt scenarios such as ISLOCA.

When core damage in ATWS scenarios cannot be prevented, opening of the PORVs is suggested. Loss of primary inventory is much faster, but creation of steam bubbles will stop the fission process. Also induced SGTR is less probable because of lower primary pressure. In case induced SGTR cannot be prevented lower pressure still helps. Opening of the secondary relief valves is less probable in that case.

Use of PSA source terms for emergency planning & preparedness

In the unlikely event that a severe event occurs at the plant with a serious threat for an off-site emergency, the 16 defined source terms in the PSA of Borssele are used as input for the prognosis. These source terms are already included as default input data in the computer codes being used for forecasting the consequences.

For the definition of the planning zones for evacuation, iodine prophylaxis and sheltering, originally the PWR-5 source term from WASH-1400 (Rasmussen Study) was taken as a conservative reference source term. Because the dose criteria for evacuation, iodine prophylaxis and sheltering were lowered, a re-evaluation of the reference source term was performed by the ANVS. Doing nothing would have resulted in (emergency) planning zones becoming significantly larger than before and also larger than actually needed. Therefore, a more realistic source term was developed, tailored to the characteristics of Borssele NPP, matching the existing planning zone.

2.4 Transition to a more Risk-Informed-Regulation

The Regulatory Body (RB) increasingly was confronted with design or operational changes which originated directly from, or were supported by arguments stemming from LPSA-applications at Borssele NPP, and which required approval by the RB. Therefore the IAEA was asked in 1999 to advice in order to support this process. The focal points of this review are illustrated by questions like:

"*Are the LPSA-applications at the Borssele NPP state-of-the-art and sufficient, or should the operator do more*?", "*How should the ANVS respond to these applications, given a small regulatory staff and possible short remaining lifetime of the Borssele NPP*?".

Among others the recommendations to the RB were:

- Develop a framework for the use of risk information in regulatory decisions. This should include the identification of objectives, description of the decision-making process and acceptance criteria, and clarification of how risk-informed decision-making is to be incorporated in the existing regulations.

Since developing such a framework may take considerable effort, they were suggested to review existing risk-informed frameworks, bearing in mind that acceptance criteria need to be developed for the specific situation in the Netherlands.

- The resources required for accomplishing risk-informed regulation depend on how much use will be made of this approach, however, the IAEA team suggested that, as a minimum, the ANVS should continue to allocate one person, having in-depth knowledge of the Borssele PSA, for PSA-related activities, and that all decision-makers should have some training in PSA.
- Finally, IAEA suggested the ANVS to use the PSA to focus the regulatory inspection programme on the more significant systems, components, and plant practices.

As a follow-up of this advice, the predecessors of the ANVS introduced a more risk-informed regulation. Since then a number of risk informed decisions have been made within the supervision activities, like as mentioned optimisation of Technical Specifications.

Nowadays the policy on supervision and enforcement includes the element of the risk-oriented approach or graded approach.

Appendix 3 Requirements & Safety Guides for the Borssele NPP Licence

In the licence of the NPP, in licence condition II.B.7, Nuclear Safety Rules and Guidelines are referred, documented in NVRs. These are listed below.

NVR NS-R-3	'*Beoordeling van de vestigingsplaats voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Requirements Safety Standard Series No. NS-R-3, Site Evaluation for Nuclear Installations Safety Requirements
NVR NS-G-3.1	'*Externe door de mens veroorzaakte gebeurtenissen bij de beoordeling van de vestigingsplaats voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.1, External Human Induced Events in Site Evaluation for NPPs
NVR NS-G-3.2	'*Verspreiding van radioactieve stoffen in lucht en water en beschouwing van de verdeling van de bevolking bij de beoordeling van de vestigingsplaats voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.2, Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for NPPs
NVR NS-G-3.3	*'Beoordeling van seismische gebeurtenissen van invloed op de veiligheid van kernenergiecentrales'*
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.3, Evaluation of Seismic Hazards for NPPs
NVR NS-G-3.4	*'Meteorologische gebeurtenissen bij de beoordeling van de vestigingsplaats voor kernenergiecentrales'*
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.4, Meteorological Events in Site Evaluation of NPPs
NVR NS-G-3.5	*'Beoordeling van overstromingsgevaar voor kernenergiecentrales met vestigingsplaats aan de kust of aan een rivier'*
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.5, Flood Hazard for NPPs on Coastal and River Sites
NVR NS-G-3.6	*'Geotechnische aspecten bij de beoordeling van de vestigingsplaats en funderingen voor kernenergiecentrales'*
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-3.5, Geotechnical Aspects of Site Evaluation and Foundations for NPPs
NVR NS-R-1	*'Veiligheid van kernenergiecentrales: veiligheidseisen voor het ontwerp'*
	Adaptation of: IAEA Safety Requirements Safety Standard Series No. NS-R-1, Safety of Nuclear Power Plants: Design Safety Requirements

NVR NS-G-1.1	*'Programmatuur voor computergestuurde veiligheidsrelevante systemen voor kernenergiecentrales'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.1, Software for Computer Based Systems Important to Safety in NPPs
NVR NS-G-1.2	*'Veiligheidsbeoordeling en -verificatie voor kernenergiecentrales'* Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.2, Safety Assessment and Verification for NPPs
NVR NS-G-1.3	'*Veiligheidsrelevante meet- en regelsystemen voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.3, Instrumentation and Control Systems Important to Safety in NPPs
NVR NS-G-1.4	'*Ontwerp van splijtstofhantering en -opslag systemen in kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.4, Design of Fuel Handling and Storage Systems in NPPs
NVR NS-G-1.5	'*Externe gebeurtenissen met uitzondering van aardbevingen in het ontwerp van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.5, External Events Excluding Earthquakes in the Design of NPPs
NVR NS-G-1.6	'*Seismisch ontwerp en kwalificatie voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.6, Seismic Design and Qualification for NPPs
NVR NS-G-1.7	'*Bescherming tegen interne branden en explosies in het ontwerp van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.7, Protection Against Internal Fires and Explosions in the Design of NPPs
NVR NS-G-1.8	'*Ontwerp van noodstroom systemen voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.8, Design of Emergency Power Systems for NPPs
NVR NS-G-1.9	'*Ontwerp van het reactor koel- en aanverwante systemen in kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.9, Design of the Reactor Coolant System and Associated Systems in NPPs
NVR NS-G-1.10	'*Ontwerp van reactor insluiting systemen voor kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.10, Design of Reactor Containment Systems for NPPs
NVR NS-G-1.11	'*Bescherming tegen interne gevaren anders dan branden en explosies in het ontwerp van kernenergiecentrales*' Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.11, Protection Against Internal Hazards other than Fires and Explosions in the Design of NPPs

NVR NS-G-1.12	'*Ontwerp van de reactor kern voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.12, Design of the Reactor Core for NPPs
NVR NS-G-1.13	'*Stralingsbescherming aspecten in het ontwerp voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-1.13, Radiation Protection Aspects of Design for NPPs
NVR NS-R-2	'*Veiligheid van kernenergiecentrales: veiligheidseisen voor de bedrijfsvoering*'
	Adaptation of: IAEA Safety Requirements Safety Standard Series No. NS-R-2, Safety of Nuclear Power Plants: Operation Safety Requirements
NVR NS-G-2.1	'*Brandveiligheid in de bedrijfsvoering van kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.1, Fire Safety in the operation of NPPs
NVR NS-G-2.2	'*Bedrijfslimieten en –voorwaarden en bedrijfsvoeringsprocedures voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.2, Operational Limits and Conditions and Operating Procedures for NPPs
NVR NS-G-2.3	'*Wijzigingen aan kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.3, Modifications to NPPs
NVR NS-G-2.4	'*De bedrijfsvoeringsorganisatie voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.4, The Operating Organisation for NPPs
NVR NS-G-2.5	'*Beheer van de kern en splijtstof hantering voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.5, Core Management and Fuel Handling for NPPs
NVR NS-G-2.6	'*Onderhoud, toezicht en in-service inspecties in kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.6, Maintenance, Surveillance and In-service Inspection in NPPs
NVR NS-G-2.7	'*Straling bescherming en radioactief afval tijdens het bedrijven van kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.7, Radiation Protection and Radioactive Waste Management in the Operation of NPPs
NVR NS-G-2.8	'*Werving, kwalificatie en training van personeel voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.8, Recruitment, Qualification and Training of Personnel for NPPs
NVR NS-G-2.9	'*Inbedrijfstelling voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.9, Commissioning for NPPs

NVR NS-G-2.10	'*Periodieke veiligheidsbeoordeling voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.10, Periodic Safety Review of NPPs
NVR NS-G-2.11	'*Een systeem voor de terugkoppeling van ervaringen van gebeurtenissen in nucleaire installaties*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.11, A System for the Feedback of Experience from Events in Nuclear Installations
NVR NS-G-2.12	'*Verouderingsbeheer voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.12, Ageing Management for NPPs
NVR NS-G-2.13	'*Beoordeling van seismische veiligheid voor bestaande nucleaire installaties*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.13, Evaluation of Seismic Safety for Existing Nuclear Installations
NVR NS-G-2.14	'*Bedrijfsvoering van kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.14, Conduct of operations at NPPs
NVR NS-G-2.15	'*Beheer van zware ongevallen voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. NS-G-2.15, Severe Accident Management Programmes for NPPs
NVR GS-R-3	'*Het managementsysteem voor faciliteiten en activiteiten*'
	Adaptation of: IAEA Safety Requirements Safety Standard Series No. GS-R-3, The Management System for Facilities and Activities
NVR GS-G-3.1	'*Toepassing van het managementsysteem voor faciliteiten en activiteiten*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-3.1, Application of the Management System for Facilities and Activities
NVR GS-G-3.5	'*Het managementsysteem van nucleaire installaties*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-3.5, The Management System of Nuclear Installations
NVR GS-R-4	'*Veiligheidsbeoordeling voor faciliteiten en activiteiten*'
	Adaptation of: IAEA Safety Requirements Safety Standard Series No. GS-R-4, Safety Assessment for Facilities and Activities
NVR GS-G-4.1	'*Vorm en inhoud van het veiligheidsrapport voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-4.1, Format and Content of the Safety Analysis Report for NPPs
NVR SSG-9	'*Seismische gevaren bij de beoordeling van de vestigingsplaats voor nucleaire installaties*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-9, Seismic Hazards in Site Evaluation for Nuclear Installations

NVR SSG-2	'*Deterministische veiligheidsanalyse voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-2, Deterministic Safety Analysis for NPPs
NVR SSG-3	'*Ontwikkeling en toepassing van niveau 1 probabilistische veiligheidsanalyse voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-3, Development and Application of Level 1 Probabilistic Safety Assessment for NPPs
NVR SSG-4	'*Ontwikkeling en toepassing van niveau 2 probabilistische veiligheidsanalyse voor kernenergiecentrales*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. SSG-4, Development and Application of Level 2 Probabilistic Safety Assessment for NPPs
NVR GS-R-2	'*Gereedheid voor en bestrijding van een nucleaire of radiologische noodsituatie*'
	Adaptation of: IAEA Safety Requirements Safety Standard Series No. GS-R-2, Preparedness and Response for a Nuclear or Radiological Emergency
NVR GS-G-2.1	'*Voorbereiding voor de gereedheid voor en bestrijding van een nucleaire of radiologische noodsituatie*'
	Adaptation of: IAEA Safety Guide Safety Standard Series No. GS-G-2.1, Arrangement for Preparedness and Response for a Nuclear or Radiological Emergency
NVR SSG-30	'*Safety Classification of Structures, Systems and Components in Nuclear Power Plants*'
	Adaptation of: IAEA Specific Safety Guide No. SSG-30
NVR 3.2.1	Voorschriften Opleiding van Bedieningspersoneel van Kernenergiecentrales

Appendix 4 Technical Details of Borssele NPP

4.1 Technical specifications

The Borssele nuclear power plant is a light water PWR with a thermal power of 1366 MW and a net electrical output of approximately 485 MW. The installation is a two-loop plant designed by Siemens/KWU. The plant has been in operation since 1973. The reactor and the primary system, including steam generators, are in a spherical steel containment. This steel containment is enveloped by a secondary concrete enclosure.

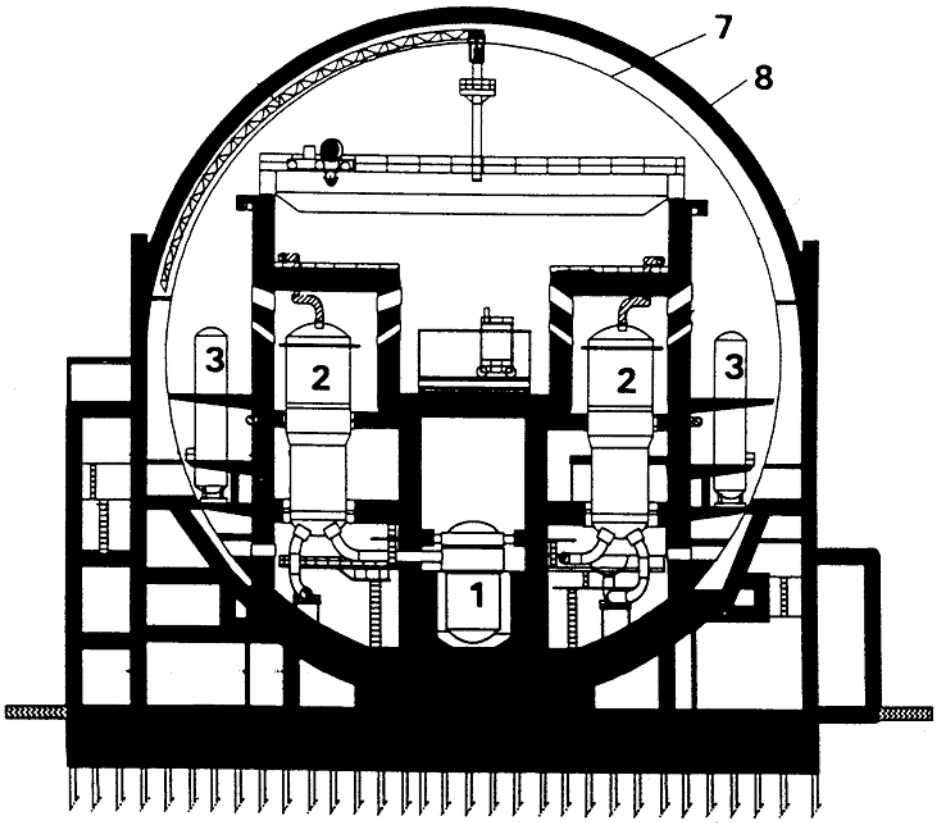
The Borssele NPP characteristics can be found in the following publications:

- The Netherlands' National Report on the post – Fukushima Daiichi stress test for the Borssele NPP, published in December 2011[88];
- The report by LH EPZ on the Complementary Safety margin Assessment (CSA, a.k.a. 'stress test'), published October 31 2011[89].

At the end of this Appendix graphs of the overall plant availability over the years, the number of incident reports, the number of unwanted automatic scrams over the years, etc. can be found.

[88] http://www.rijksoverheid.nl/bestanden/documenten-en-publicaties/rapporten/2011/12/20/nationaal-rapport-over-de-stresstest-van-de-kerncentrale-borssele/netherlands-national-report-on-the-post-fukushima-stress-test.pdf)
[89] http://www.kerncentrale.nl/resultatenrobuustheidsonderzoek/EN/)

Figure 7 Cross-section of reactor building of Borssele NPP



1. Reactor pressure vessel
2. Steam generator
3. Medium-pressure core inundation buffer tank
7. Steel containment
8. Secondary concrete enclosure (shield building)

4.2 The first 10-yearly Periodic Safety Review

In the late 1980s, mainly as a result of the Chernobyl accident, the Dutch government formulated an accident management and backfitting policy. Both existing utilities at that time (Borssele and Dodewaard NPP) were asked to upgrade the safety of their plants by incorporating state-of-the-art features. With the aid of the respective reactor suppliers, the two utilities developed a new safety concept for their plants in the early 1990s. The utility operating the Borssele NPP (which was 20 years old at the time) embarked on a € 200 million modification programme, while Dodewaard NPP was closed because of economic reasons.

The new safety concept was largely based on a comparison of the plant's current design basis with national and international deterministic nuclear safety rules; deterministic studies of the plant; insights gained from similar designs; operating experience and, last but not least, insights derived from the German Risk Study (DRS-B). A plant-specific PSA was performed in parallel with the activities for the conceptual design. This PSA played a major role in later stages of the modification programme. Once the safety concept had been finalised, it was translated into a 'safety plan', consisting of a package of

modification proposals for the plant systems, structures and components. In the CNS-5 report published many years ago an extensive list of important modifications can be found.

The main goals of the safety improvements were:

- Extensive improvement of functional and physical separation of redundant systems and increase of redundancies and some diverse systems;
- Improvement of protection against external events (e.g. reserve residual heat removal by well pumps, emergency control room in hardened building, emergency response centre in bunker);
- Improve protection against LOCA, SB-LOCA, MSLB, SGTR and SBO;
- Improve AM and SAM (introduction of SAMG's, PAR's and filtered venting, bleed and feed);
- Modernisation of control room and full-scope simulator.

4.3 The second 10-yearly Periodic Safety Review

The Borssele NPP in 2003 finalised its second 10-yearly periodic safety review. It included a safety evaluation of the period 1993-2002, the drawing-up of proposals for adaptations of the technical, organisational, personnel and other provisions to achieve state-of-the-art conformity, as well as the implementation of the proposed measures. This second ten-yearly safety review resulted in a fine-tuning of the safety concept of the plant rather than major changes. The safety-interests of the improvement-issues were estimated, from a nuclear safety point of view as well as from a radiation protection point of view using both deterministic and probabilistic considerations.

Specific attention in this safety review was paid to:

- International developments and views relating to e.g. backfitting programmes and other reactor designs;
- Ageing, including selection of the Structures, Systems and Components to be reviewed and ageing management;
- State-of-the-art PSA analyses;
- Evaluation of good practices;
- Safety analyses with respect to external conditions;
- Accident management and severe accidents;
- Fire protection.

The probabilistic safety interest of an improvement issue is based upon the maximum possible decrease of the core damage frequency (TCDF PSA level 1) and the decrease of the individual risk (IR PSA level 3). For each echelon of the defence in depth concept modifications have been suggested. In the period 2005-2007, the majority of the modifications was implemented.

The main goal in the technical area was to further strengthen the safety concept that was introduced in the 1st PSR. On the other hand to put increased efforts in the area of safety analysis, ageing aspect, the organisation and emergency procedures. A list of improvements has been presented in the past CNS-5 report. Some items were still relevant during the more recent post-Fukushima Daiichi evaluations:

Technical measures

- Increasing the supply of diesel oil in the bunker systems from 24 hours to 72 hours;
- Installation of a second reserve cooling water (TE) pump;
- Automatic starting of the bunkered primary reserve injection system if the level in the RPV becomes too low during midloop operation.

Organisational, personal and administrative measures

- Improvement of the Emergency Operating Procedures (EOPs) with regard to avoiding dilution of the primary coolant after start-up of a main coolant pump;
- Implementation of Severe Accident Management Guidelines (SAMGs) for low-power and shut-down modes of operation;
- Implementation of an E-0 optimal recovery guideline for low-power and shut-down modes of operation (E-0 = reactor trip and safety injection, diagnostics).

Man-machine interface (MMI) and emergency procedures

MMI was an important topic in the Borssele backfitting programme that was implemented in 1997. It encompassed:

- Enlargement and complete retrofit of the main control room;
- Addition of a secondary (emergency) control room in a new external events hardened building;
- A full-scope replica simulator (at a training centre in Germany), including main and secondary control room;
- An emergency response and communication facility in the cellar under the office building.

With the introduction of the Westinghouse procedures in the middle of the nineties also the Critical Safety Functions monitor was introduced in the control room.

At the Borssele NPP, an integrated Event-Based and Symptom-Based package of Emergency Operating Procedures (EOPs) is used:

The Optimal Recovery Guidelines (ORGs); 'Event'-based procedures for LOCA, Secondary Line Break, SGTR and combinations of these.

The Function Restoration Guidelines (FRGs); 'Symptom'-based procedures for the overall safety of the plant.

In the CNS-5 report for the fifth review meeting more details about the design of the MMI and the control room can be found in its Annex on the Technical Details of Borssele NPP.

4.4 The third 10-yearly Periodic Safety Review

In compliance with the licence the LH issued a third 10-yearly safety review at the end of 2013. The Safety Report of 20 years before (VR93) contained a statement that the design of the plant is based on an operating period of 40 years starting from 1973. Therefore the LH had to apply for a licence approving Long Term Operation (LTO). This had to be supported by sound evidence that the plant can be safely operated for a longer period. It was agreed by the ANVS and EPZ not to combine the two subjects of LTO and PSR but to execute two complementary projects, each having its own time frame. The LTO project resulted in a licence application that was submitted for regulatory review in 2012; the licence was granted in 2013. The LTO project was carried out using IAEA Safety Report Series 57, complemented with two safety factors: SF10 Organisation, Management System and Safety Culture and SF12 Human Factors from the IAEA guidance on PSR.

The LTO process was supported by a limited scope IAEA SALTO mission in 2009, with the aim to see if the LTO-programme and approach was comprehensive and according to the state-of-the-art. At the end of the LTO programme and in the phase of the licensing a full-scope SALTO mission was carried out in May 2012, covering also the follow-up on the mission in 2009. The final LTO-licence was given in March 2013, including the provision to complete the measures based on the SALTO mission recommendations before the end of 2013. In February 2014 the final follow-up SALTO mission was carried out. All SALTO recommendations had been implemented by then, except for the final verification for the RPV integrity (based on assessment of surveillance specimens) that was completed later in 2019.

During the 3rd PSR amongst others the following steps were relevant:

- DS426, update version of IAEA NS-G-2.10 was used as guidance;

- A benchmark study of PWRs of the same age and with LTO;
- A benchmark study of the EPR (including Finnish regulations) and AP1000;
- Study of the 2010 WENRA document “Safety objectives for new reactors”;
- Modernisation of deterministic safety analyses;
- Lessons learned Fukushima Daiichi accident;
- Use of PSA to determine potential safety improvements.

Eleven measures agreed after the third PSR required a modification of the licence. Together with the modification, EPZ applied for a revision of the licence as was requested by the RB. As part of the application, a revised Safety Report was submitted to the ANVS.

The evaluation report on the third PSR was finished by the end of 2013. It yielded more than 100 recommendations. A number of actions from the European stress test merged with the measures that were based on the third PSR. Eleven modifications had such influence on the safety report that a modification of the licence was necessary. They modifications are listed below and were implemented.

The allowance for long-term operation until 2034 made it unavoidable to replace the still analogue reactor control and limitation systems (RCLS) of the Borssele NPP with digital systems. These replacements were carried out in 2017.

4.5 The fourth 10-yearly Periodic Safety Review

In the most recent 10-year safety review the compliance with basic design requirements was again assessed and new safety improvements have been identified. For instance, in accordance with licence requirement C.40, the neutron fluence on the reactor vessel was evaluated during this 10-year safety evaluation. This was as expected. In addition and in accordance with license requirement D.4, a fundamental evaluation and update of the fire risk analysis report and the fire safety strategy document was carried out, and in accordance with license requirement B.16, the probabilistic safety analysis (PSA) was tested and adapted to state of the art knowledge and solutions. The findings of the 10-year safety evaluation were reported in a Global Assessment which provided a balanced picture of the evaluation results, the identified points of interest and the potential safety improvements. The impact of the potential improvements to nuclear safety has subsequently been weighed against their cost. Based on this cost/benefit assessment, potential measures have been selected for an integrated safety assessment in the next phase. The final decision for the implementation of measures has taken place on the basis of this integrated safety assessment.

With regard to the motto of 10EVA23, reducing complexity, the design evaluation resulted in a number of specific improvements to correct a few deviations from the safety concepts applied to the design of the power plant. These include redundancy separation and automatic start of emergency power components. The same motto was applied to documentation and procedures and small improvements were identified to make things more logical and clear. Fewer exceptions to procedures reduce complexity and therefore the chance of errors. The review also identified a number of potential improvements with regards to the design and interconnection of the business processes and the organisation. This also helps to reduce complexity.

The review did not detect any deviations that had such a safety significance, or constitute such a deviation from regulations, that they would endanger the operation of the installation in accordance with the license.

The process resulted in a package of potential measures that will bring and maintain the safety of the KCB at an (even) higher level. The review therefore provides sufficient substantiation for continued business operation.

With the submission of the Global Assessment report to the ANVS, the 10-year safety evaluation 10EVA23 was formally completed at the end of 2023 and the operator is currently in the process of implementing the improvements that were selected in the integrated safety assessment.

A summary of the planned improvements from the fourth Periodic Safety Review are:

- Improved prevention of station blackout situations;
- Improvements in electrical configurations and emergency power;
- Preventing deviations to the redundancy concept;
- Improved fire protection;
- Improvements in configuration management;
- Changes to emergency procedures;
- Simplification of commissioning and decommissioning procedures;
- Updating the probabilistic safety assessment;
- Implementation of a radioactive waste reduction programme;
- Improvements to the emergency response organisation;
- Improvement of the maintenance programme;
- Development of a technical obsolescence programme;
- Improvement of the personnel management process;
- Improvements to the radiation protection programme and reduction of the radiation exposure of workers.

4.6 Analysis of past incidents

Unexpected activation of reactor safety signals June/July 2023 (INES 0)

In June 2023 there was an unexpected activation of a reactor protection system signal that opened a valve towards the blow-off valves. There was no blow-off active, so nothing was blown off. At the time of the incident EPZ was were unable to reproduce the unexpected activation. However after this incident monitoring equipment was placed on the electronics to measure something if it would happen again. In July the same activation happened. This time, because monitoring was put in place they were able to trace what the problem was. It was discovered that there was a problem with an electronic module. The defective module was replaced. Research on the defective module showed that there was a defect in a solder joint that existed from production that was activated due to aging. The other building blocks of the same type were checked for similar defects.

Employees exposed to higher than expected radiation April 2023 (INES 1)

During shutdown the reactor is checked for loose particles using an underwater robot. A loose particle was discovered in a place where it would cause damage to the fuel rods during operation; the particle was therefore removed. During removal the dose rate in the area above the reactor basin increased to 10 mSv/h.

Two employees working on the removal of the particles received a dose of approximately 70 microSv. The day dose the employees were allowed to receive that day was 500 microSv. During the manipulation of the particle the radiation monitors gave an alarm. It was concluded that the particle had a high dose rate. The particle was placed in a temporary spot that contained enough shielding and was eventually removed.

The incident was analysed and as a result several underlaying causes were identified. There was a work licence to inspect, but there had not been put enough thought into what would happen if something was found and how it should be retrieved. This was a gap in the work preparation and also a lack of critical thinking. There also was no communication about the proposed activity of retrieving the particle with the radiation safety officer. Human factors therefore played a big role in this incident. The measures to prevent something similar from happening in the future are an extra step in the preparation of work with

materials that might have a high dose rate and the improvement of documents concerning inspection on loose particles, and possible risk when retrieving them.

4.7 Data on radiation protection and exposure

Downward trend in personnel doses

There has been a downward trend in the average effective individual dose at the Borssele plant ever since 1983. This is true both for plant personnel and for externally hired personnel. In the early eighties, the average effective individual dose was 4 mSv per annum for Borssele personnel and 5 mSv per annum for externally hired personnel. By the end of the nineties, the figures had decreased to 1 mSv and 1.5 mSv respectively. The trend of low doses has continued past the millennium.

The trend in the collective dose has been very similar to that in the individual doses. The total collective dose amounted to 4 personSv per annum in the early eighties. By the end of the nineties it had decreased to 1.0 personSv per annum. The trend of low doses has continued past the millennium.

Apart from the regular activities, the large modification activities carried out in 1997 resulted in an additional collective dose of 1.8 personSv. The highest individual dose received in that year was 14.0 mSv.

Release limits

The discharge limits are listed below.

Table 6 Allowed releases into air per annum

Pollutant	Amount	Unit
Noble gases	500	TBq
Halogens	50	GBq (*)
Aerosols	500	MBq
Tritium	2	TBq
Carbon-14	300	GBq

(*) of which a maximum of 5 GBq I-131

Table 7 Allowed releases into water per annum

Pollutant	Amount	Unit
Alpha emitters	200	MBq
Beta/gamma emitters (excl. 3H)	200	GBq
Tritium	30	TBq

Maximum and estimated doses to the public

The maximum dose consequences to members of the public[90] if the releases happened in amounts equal to the aforementioned limits are estimated to be:

- Maximal individual dose from releases in air: about 0.7 microSv per annum;
- Maximal individual dose from releases in water: about 0.01 microSv per annum.

[90] The legal dose limits for members of the public are as follows: dose limit for any one source is 0.1 mSv per annum, limit for all sources together is 1 mSv per annum. See among others Appendix 1 for the background of these numbers

Appendix 5 High Flux Reactor

5.1 Technical characteristics

The HFR is a relatively large research reactor with a current thermal output of 45 MWth. It is a tank in pool type reactor of a design similar to the old Oak Ridge Reactor in the USA. Comparable reactors are the R2 reactor in Studsvik, Sweden and the Safari reactor in Palindaba, South Africa. The latter is still in operation.

The aluminium reactor vessel with 4.5 cm thick walls (core box) is located at the bottom of a 9 m deep pool. It operates at a low primary pressure of several bars. In 1984 the first reactor vessel was replaced by the current vessel, partly because radiation-induced embrittlement of the core box was suspected. Later, it turned out that this embrittlement was far less than anticipated. The reactor vessel and the reactor pool are located inside a gas-tight steel containment with a 25 m diameter and 12 mm thick walls. A closed primary cooling circuit is connected to the reactor vessel. This primary circuit consists of 16" and 24" aluminium piping, a 43 m^3 decay tank, three electrically driven main primary cooling pumps and three heat exchangers. The heat is discharged by an open secondary system, pumping water from a canal to the sea. The decay tank, primary pumps and heat exchangers are located in a separate pump building, together with two electrically-driven decay heat removal pumps. In addition, decay heat can also be discharged by natural circulation over core and pool.

The HFR has 20 in-core and 12 poolside irradiation positions, plus 12 beam tubes. The in-core positions are mainly employed for material irradiation, experiments and fuel irradiation programmes. Radioisotopes production is performed in both irradiation positions.

The HFR was originally designed to operate with over 89% high enriched U.Alx as fuel. In 2005 a new licence was issued to operate the reactor in future using low enriched uranium (LEU) with an enrichment of less than 20%. The conversion from HEU to LEU was completed in the autumn of 2006. Targets to produce medical isotopes then were still based on HEU, but the introduction of LEU targets was also pursued and a licence application was submitted for that purpose in 2016. The licence was granted in 2017. In 2020 the last HEU target was irradiated completing the conversion programme.

More technical details of the HFR can be found in the CNS-5 report published in September 2010 for the fifth review meeting of the CNS in April 2011. The details are not repeated in the present report.

5.2 History and use of the HFR

The construction of the facility began in the mid-fifties at the Petten site, a location in the dunes close to the sea. The reactor core achieved criticality for the first time in 1961. In 1962, following a special request by the Dutch government, an agreement between the Dutch government and the European Community for Atomic Energy (EURATOM) was signed by which it was decided that Petten would host one of the four Joint Research Centres (JRC). As a consequence of that agreement, ownership of the reactor was transferred to the European Committee for Atomic Energy (EURATOM) in 1962.

The reactor has been operating since 1961 with an average utilisation time of 250 to 265 days of operation per year in the last 5 years. It has 8 to 9 operating cycles per year with a 4 days maintenance outages between the operating cycles that vary in length between four days and several weeks and are used for refuelling, maintenance and modifications.

Although the Joint Research Centre (JRC) Petten became the LH, the operation and maintenance of the reactor was subcontracted to the founding organisation, Reactor Centre Netherlands. This organisation was later renamed the Energy Research Foundation Netherlands (ECN). In 1998, the nuclear branches of ECN and KEMA (a former research institute of the Electric Power Utilities) were merged and the operation of the HFR was consequently transferred to the newly formed organisation NRG (Nuclear Research and consultancy Group). NRG was also granted the right to exploit the HFR commercially.

In 2002 the HFR was temporary shutdown for more than a month for safety concerns, being indications of growing weld indications and safety culture deficiencies. After independent investigations by two different organisations, one of which was an INSARR mission in 2002 by the IAEA, the reactor was allowed to restart after the realisation of several immediate actions and the adoption of an improvement plan to be carried out in the next years. One of the advices of IAEA was the transfer of the licence from the JRC to the operator NRG, which was realised in 2005 in connection with the updated licence after the first periodic safety review.

Although much of the use of the reactor is still in the field of materials research, including new fuel types, the reactor is increasingly being used for medical applications i.e. radioisotopes for diagnostic purposes and patient treatments.

5.3 Modifications and PSRs

Modifications

Important modifications that have required oversight of and approval by the Regulatory Body include:

- A replacement of the trolley of the polar crane in the HFR reactor building;
- A modification in the design of the control rods to improve the structural integrity of the component;
- Measures to improve resistance to internal flooding events;
- Strengthening of the security arrangements around the HFR site;
- Several new utilisation facilities for performance of experiments or production of radio-isotopes;
- Restoration of the functionality of the facility system;
- Expansion tank pipe integrity improvement.

First PSR

From 2002 to 2005 a first periodic safety review (PSR) was executed. This process is required to be conducted every ten years and includes a full-scope PSA. References were the existing IAEA rules and regulations for research reactors, complemented with some principles applied in nuclear power reactors. The design basis got newly defined by a complete set of PIE analyses. Ageing and operating experience were investigated and there was a survey of the state-of-the-art, which included visits to other research reactors. A probabilistic risk scoping study complemented the safety analyses. The safety review resulted into a list of recommendations and suggestions. This led to a Safety Design and Modification Concept. The most important modifications were described in the aforementioned nuclear licence of 2005.

Second PSR

The HFR conducted a second PSR in 2012-2014 and submitted the report for regulatory review. The activities performed with the PSR show that it was conducted in accordance with the IAEA safety standards for nuclear power plants (SSG-25) with use of a graded approach. The review included fifteen safety factors and global assessment based on findings from the safety factors review. The implementation plan for safety improvements is being implemented.

Third PSR

The third PSR has been completed and submitted for regulatory review by the end of 2022. The approach is similar to the second PSR making use of the newly developed IAEA guide for PSR for Research Reactors (Safety Report Series 99). The review included fifteen safety factors and global assessment based on findings from the safety factors review. The implementation plan for safety improvements is being executed. Most of the improvements aim on improving processes and documentation.

5.4 Important major licence renewal

In 2016 there was a major update of the licence that included among others:

- Transfer of the licence of a building for Non-Destructive Testing (NDT) from JRC to NRG;
- Change of some storage facilities for temporary storage of materials for maintenance and construction activities;
- Formalisation of already implemented safety measures stemming from the first PSR, that were implemented in a way differing from the original plan;
- Measures stemming from the 'stress test', like increase of volume of diesel fuel for emergency diesel generator, and flexible decentral emergency power supplies;
- Changes to the licence, that take account of changes in the regulatory framework, and changes in the organisation of the Regulatory Body (many entities merged into the ANVS).

5.5 IAEA INSARR and other recent missions at the HFR

The HFR has a long history of receiving IAEA missions. Refer to earlier CNS-reports for information on missions till 2016.

More recent missions can be found in Appendix 6.

5.6 Incidents

For this rapport two incidents will be described.

Defective monitors discovered during inspection November 2022 (INES 0)

During the reactor stop maintenance was performed on the water monitoring system. It was then discovered that both monitors seem to not have been working as they should. The fission products monitor showed lower values than was common and the secondary coolant monitor did not work.

For both monitors the cause of the defect have been researched. For the fission products monitor it is expected that the higher voltage setting has caused quicker aging on the monitor. It was also concluded that during regular inspection and maintenance the settings were checked, but not the detector itself; there was also not a minimum value set for this monitor, which caused the lower value to not be registered. For the secondary coolant monitor the cause was discovered to be a low sensitivity of the monitor. This low sensitivity was caused by defects in the electronics caused by aging. This monitor did give a normal value that did not differ from the normal value, but because this monitor was not checked with a radioactive source it was not noticed that it would not register the right value if it would detect something.

Readings from other monitors show that there have not been elevated values during the time these monitors were defective. The complete replacement of the water monitoring system was already planned for that reactor stop. The defective monitors were therefor replaced with new monitors and it was shown that these monitors all worked properly. To make sure that defective monitors will be detected earlier weekly checks with a source, yearly calibration and trend analyses will be performed.

Leak through a bottom plug hole March 2024 (INES 0)

During regular shutdown of the reactor a leak was discovered at one of the pipe-holes at the bottom of the bottom plug of the reactor. The bottom plug is a concrete plug that contains pipe-holes through which experiments could be inserted into the reactor vessel. These holes have not been in use for years and the reactor side of these holes has been made inaccessible during the replacement of the reactor vessel in 1983. Because of this the reactor side of these holes is also not accessible for maintenance. The reactor was not started, but research was performed to discover the cause of the leak and to stop the leak.

It was discovered that the plug at the top of the pipe-hole was not intact anymore, the demin water that was in the pipe-hole contained nuclides that showed that there had been a leak from the top of primary coolant. The bottom plug was the last barrier. This plug was not leak tight anymore. To stop the leak a new plug was put into the bottom of the pipe-hole. This plug has a double seal with a monitoring system

in between the two seals. This way of the top of the two seals is damaged the water will be detected before it leaks out of the bottom plug.

5.7 3D representations of the HFR

Figure 8 3D cross section of the reactor building of the HFR

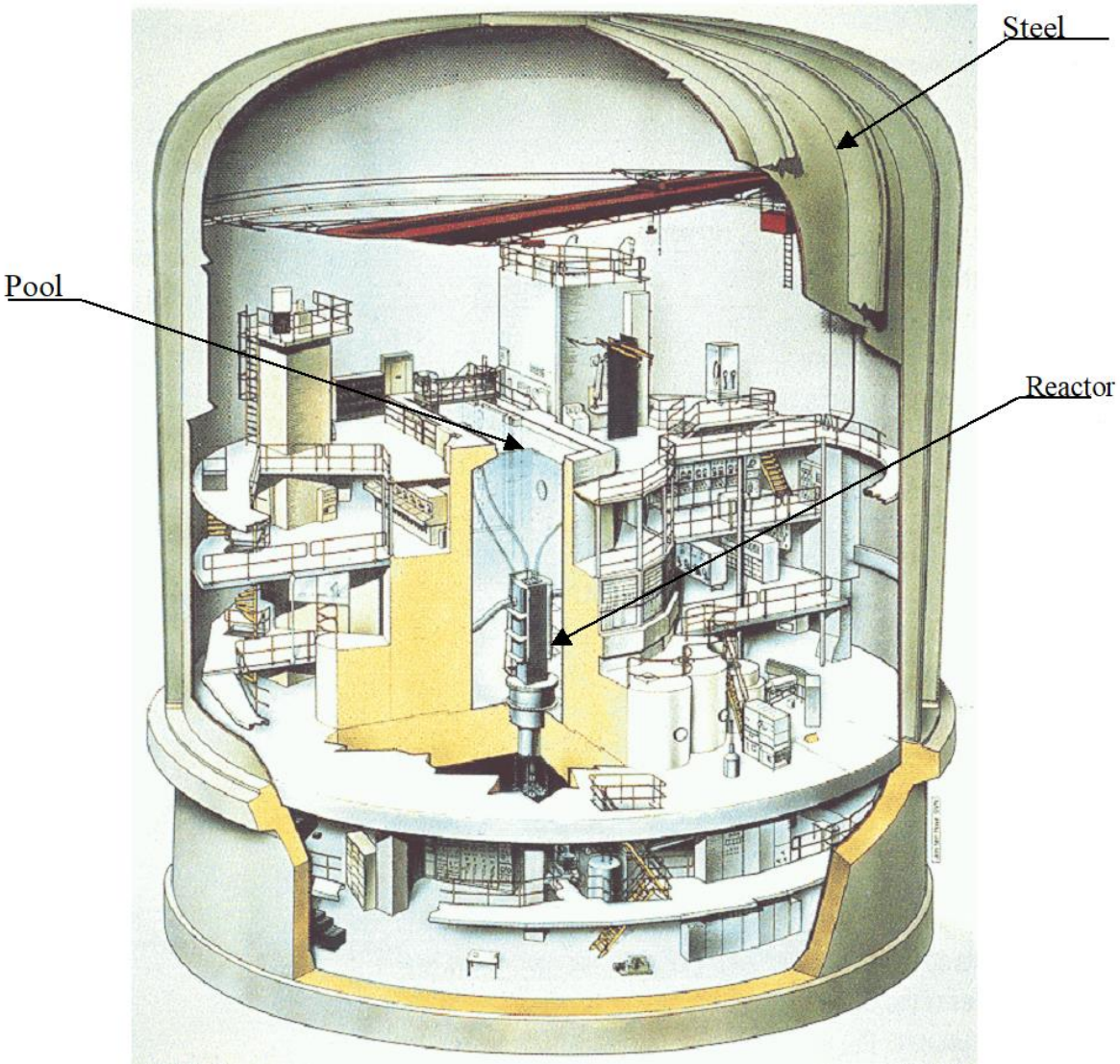
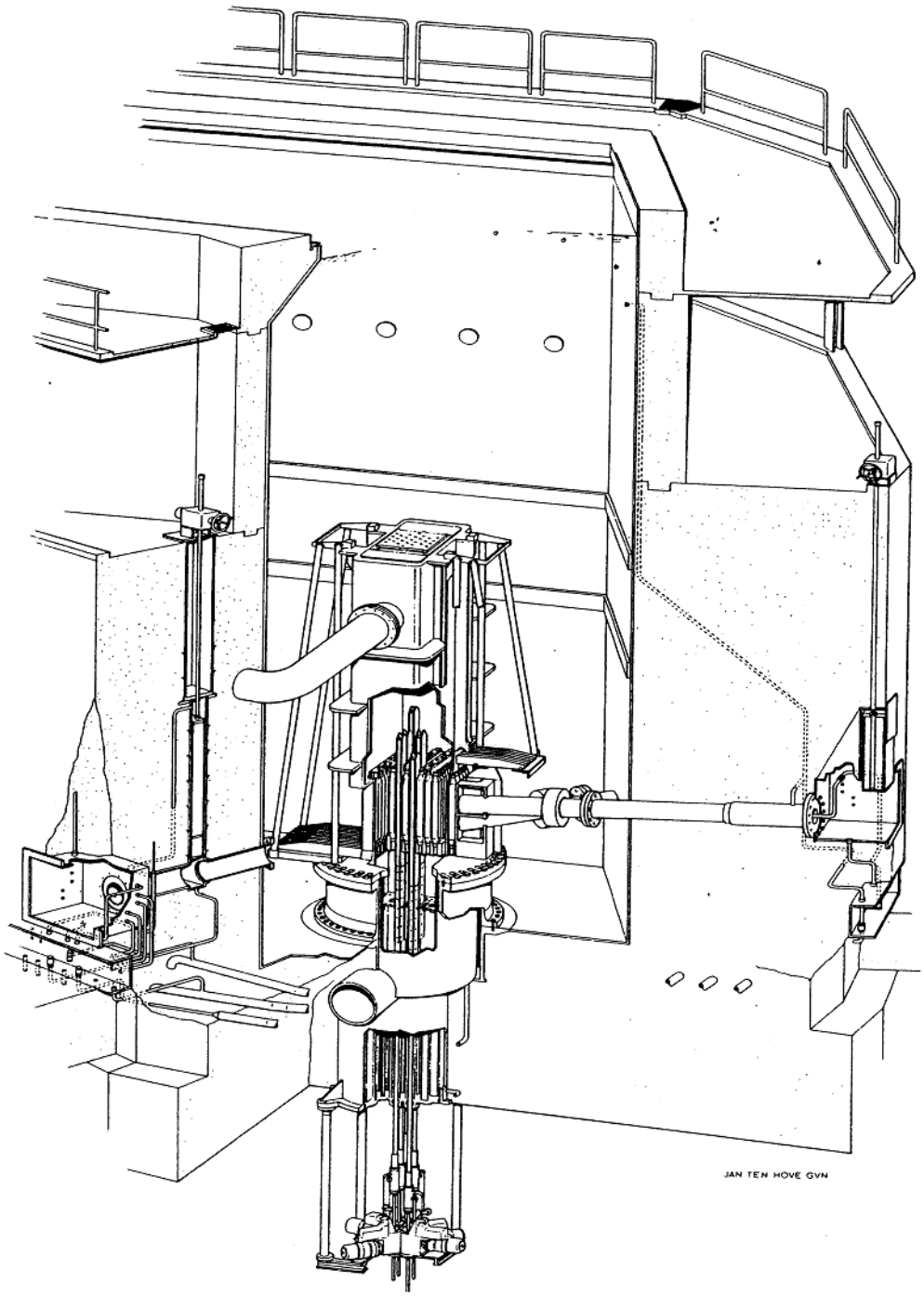


Figure 9 Reactor vessel in reactor pool in the HFR



Appendix 6 Additional Information on Missions to HFR, HOR and RB

6.1 Missions to the HFR

INSARR / ISCA Missions

The INSARR mission in fall 2016 followed-up the results of the mission in 2011. The report is publicly available. In 2017 there was an Integrated Safety Culture Assessment (ISCA mission) to the broader NRG operations branch (including the HFR).

In April 2019 the 2016 INSARR and 2017 ISCA missions were both followed-up at the same time. After the follow-up the IAEA concluded that there was a high level of implementation of the INSARR recommendations. Main issues that still need attention are the revision of the safety analysis report, handling of documents by the safety committee and the development of the dismantling plan. On the ISCA side the IAEA was positive about the NRG Leadership for Safety Programme, the developments of the roles and task perceptions of all staff and training and communication on safety culture. Main issues that need attention are keeping the management system up-to-date, the functioning of the reactor safety committee and the perceptions on the workload. During the mission IAEA already looked at the scope and selection of SSCs for the LTO-programme. The licencee was advised that the safety classification and its scope shall be improved.

In June 2022 there was an LTO-mission, a Continued Safe Operation (CSO) mission, which is a kind of SALTO mission for RRs. This mission had been postponed due to the COVID-19 pandemic. Some highlights of the mission were:

- IAEA noted that the assignment of a dedicated ageing management coordinator is a good performance.
- IAEA recommends to ensure a systematic implementation of the obsolescence programme.
- IAEA recommends to update the ageing management review methodology in accordance with the standards for all in-scope civil structures and components.
- In June 2024 the follow-up of the CSO took place. The IAEA concluded that NRG has made sufficient progress on the findings from the mission.

6.2 Missions to the HOR

The HOR is the RR in Delft. In 2021 it was visited by an INSARR mission. The INSARR team noted priority to safety during the recent renovation and modernisation of the reactor and the completion of all measures that resulted from the self-evaluation (so-called stress test). The effective communication between the ANVS and the LH was noted as well.

It has been agreed that the recommendations stemming from the INSARR mission will be integrated in the final report of the 10-yearly PSR.

In 2024 the HOR was visited by a Follow-Up INSARR mission.

The IAEA team concluded that RID achieved a high level of implementation of the recommendations and suggestions of the main INSARR mission. The team assessed that 19 out of 22 recommendations had been either fully implemented or minor actions remain for their full implementation. The mission identified the need for full implementation of the other three INSARR recommendations, noting that actions have been taken or planned to address them. In addition, the results of the analysis for RID organisational restructuring options led to a new recommendation. The team also noted that all five

suggestions of the main INSARR mission were considered by RID, and significant actions had been taken for their implementation.

The IAEA team assessed that this high level of implementation of the INSARR recommendations contributed to further enhancement of the reactor safety, through strengthened organisational effectiveness, safety analysis and safety documents, and operating programmes and safety aspects of technical modifications of the facility, including:

- Strengthened safety culture by development of a programme with the support of external specialist that included identification of the main safety goals for the operating organisation and elevation of risk awareness using a systematic assessment;
- Completed analysis for RID organisational restructuring options and clarification of roles and responsibilities by updating the job descriptions of the director of RID and heads of HOR-O and HOR-B (Department of HOR Operation);
- Improved function of HOR safety committee with an established list of items to be reviewed in accordance with IAEA Safety Standards Series No. SSR-3 and establishing detailed terms of reference;
- Revised operational limits and conditions (OLCs) with clear distinctions between safety limits and safety system settings to ensure sufficient safety margins;
- Updates of the safety analysis report (SAR) and enhanced its format in accordance the IAEA Safety Standards Series No. SSG-20 (Rev. 1);
- Development and implementation of a retraining programme for the operating personnel following the major modifications;
- Improved radioactive waste management and maintenance programmes, including ageing management programme, through establishment of a new asset management tool (Archibus);
- Established categorisation process based on the safety significance of the utilisation and modification projects to determine their routes for approval and procedures for implementation.

Three INSARR recommendations remain valid and further actions are needed for their implementation. These recommendations are related to the need for further improvement of the safety analysis by re-evaluation of the fuel channel blockage event; revision of the system for area classification and zoning for radiological protection by taking into consideration the laboratories located within the reactor site; and re-establishment of the requirements on maintenance, periodic testing and inspection as part of the OLCs during the reactor prolonged shutdown period.

The new recommendation was provided on the need to complete the training programme for the newly appointed director of RID, who carries out the role of reactor manager.

6.3 IRRS missions to the RB

In 2023 the ANVS hosted three IAEA missions: Integrated Regulatory Review Service (IRRS), International Physical Protection Advisory (IPPAS) and Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS).

For the IRRS mission The IAEA mission team concluded that the Netherlands has a robust system in the field of nuclear safety and radiation protection. They have made suggestions and suggestions to further strengthen this. For IPPAS the team concluded that the Netherlands is committed to a high level of nuclear security and that it has further strengthened its nuclear security capabilities since the last IPPAS mission in 2012. The team made recommendations and suggestions to support the Netherlands in further improving and making nuclear security more sustainable. For ARTEMIS the mission team concluded that the Netherlands has an effective programme for the management of its invested nuclear fuel and radioactive waste for its current needs. The mission team further concluded that the Dutch radio waste policy is actively aligned with the radiation protection policy that protects humanity, society and the environment from the risks of ionising radiation. The recommendations and suggestions resulting from these three missions are incorporated into an action plan.

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PO Box 16001 | 2500 BA The Hague,
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