JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

National Report of the Kingdom of the Netherlands

First review conference (November 2003)

Ministry of Foreign Affairs
Ministry of Housing, Spatial Planning and the Environment
Ministry of Economic Affairs

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CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

Acronym	Full name	Translation or explanation (in brackets)
Awb	Algemene wet bestuursrecht	General Administrative Law Act
Bkse	Besluit Kerninstallaties, Splijtstoffen en Ertsen	Nuclear Installations, Fissionable Materials and Ores Decree
Bs	Besluit Stralingsbescherming	Radiation Protection Decree
BWR	Boiling Water Reactor	
BZ	Buitenlandse Zaken	(Ministry of) Foreign Affairs (the Netherlands)
COVRA	Centrale Organisatie Voor Radioactief Afval	Central Organisation for Radioactive Waste
DIS	Dodewaard Inventory System	
ECN	Energieonderzoek Centrum Nederland	Netherlands Energy Research Foundation
EIS	Environmental Impact Statement	
EPZ	Elektriciteitsproductie-maatschappij Zuidwest	(Operator of the Borssele NPP)
EZ	Economische Zaken	(Ministry of) Economic Affairs (the Netherlands)
HABOG	Hoogradioactief Afvalbewerkings- en Opslag Gebouw	High-level Waste Treatment and Storage Building
HEU	High Enriched Uranium	
HFR	High Flux Reactor	(Research Reactor of JRC in Petten)
HLW	High Level Waste	
HOR	Hoger Onderwijs Reactor	(Research reactor at the Technical University Delft)
IAEA	International Atomic Energy Agency	
JRC	Joint Research Centre	
Kew	Kernenergiewet	Nuclear Energy Act
KFD	Kernfysische Dienst	Nuclear Safety Department (the Netherlands)
LEU	Low Enriched Uranium	
LOG	Laagradioactief Opslag Gebouw	Low-level Waste Storage Building
MOX	Mixed Oxide fuel	
NEWMD	Net-enabled Waste Management Database of the IAEA	
NORM	Naturally Occurring Radioactive Material	
NPP	Nuclear Power Plant	

NRG	Nuclear Research and Consulting Group	
NVR	Nucleaire Veiligheids-Richtlijn	Nuclear safety rule (the Netherlands)
PWR	Pressurized Water Reactor	
QA	Quality Assurance	
RIVM	Rijks Instituut voor Volksgezondheid en Milieuhygiëne	State Institute of Public Health and the Environment
SAS	Stoffen, Afvalstoffen en Straling	(Directorate for) Chemicals, Waste and Radiation Protection (the Netherlands)
SE	Safe Enclosure	
SF	Spent Fuel	
SZW	Sociale Zaken en Werkgelegenheid	(Ministry of) Social Affairs and Employment
VI-ZW	VROM Inspectie Zuid-West	VROM Inspection South-west region
VROM	Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer	(Ministry of) Housing, Spatial Planning and Environment (the Netherlands)
Wm	Wet Milieubeheer	Environmental Protection Act

Introduction

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

The Netherlands has a small nuclear programme: only one nuclear power plant and a small number of research reactors are currently in operation. Consequently, both the total quantities of spent fuel and radioactive waste which have to be managed and the proportion of high-level and long-lived waste are likewise modest. Many of the radioactive waste management activities are necessarily centralized in one agency in order to take as much benefit as possible from the economy of scale. This explains why a major part of the report is devoted to the activities of COVRA, the Central Organisation for Radioactive Waste, in Borssele.

This report gives an article by article review of the situation in the Netherlands, as compared with the obligations laid down in the Joint Convention. The numeration of the chapters and sections of this report correspond with those of the Joint Convention. The sequence of the articles in the joint Convention is strictly following in the description of the situation in The Netherlands.

In the appendices quantitative information on the inventories of spent fuel and radioactive waste are given, representing the status at the end of 2002, as well as a detailed description of the policies underlying the present practices.

CHAPTER 1. OBJECTIVES, DEFINITIONS AND SCOPE OF APPLICATION

Article 3. SCOPE OF APPLICATION

Art. 3.1 This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.

The Netherlands wishes to declare that the spent fuel from its nuclear power stations, which was transferred to Cap La Hague (Fr) and Sellafield (UK) for reprocessing, will not be taken into account in its spent fuel inventory as long as it is at the reprocessing plant.

Art. 3.2 This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.

The Netherlands wishes to declare waste originating from naturally occurring radioactive materials in quantities or concentrations exceeding the exemption limits specified in the text to Article 12, as radioactive waste under the scope of this Convention.

CHAPTER 2. SAFETY OF SPENT FUEL MANAGEMENT

Article 4. GENERAL SAFETY REQUIREMENTS

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

Art. 4 (i): ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;

Spent fuel management occurs at four different locations:

a) At the site of the nuclear power station;
b) At the sites of the research reactors;
c) In the storage facility for Low and Intermediate Level Waste of the Central Organisation for Radioactive Waste (COVRA)
d) At the sites of the reprocessing plants in Cap la Hague and Sellafield.
e) In spent fuel management facilities in the US for research reactor fuel returned under prevailing contracts.

Ad a) The Netherlands has two Nuclear Power Plants (NPP's), a 480 MWe PWR in Borssele, which is in operation, and a 60 MWe BWR in Dodewaard which has been shut down in 1997 and is now in the decommissioning phase. All spent fuel has been removed from the plant and transferred to Sellafield for reprocessing. The last transport of spent fuel from Dodewaard was carried out in April 2003; for that reason, the following information is limited to the practices at the Borssele plant.

Spent fuel is kept in storage in the spent fuel pool at the reactor site of the NPP. The design of the fuel pool complies with the provisions in NVR publication 2.1.10, which is an adaptation of IAEA Safety Series No. 50-SG-D10. This design ensures the removal of residual heat from the spent fuel removed from the reactor core, while the design of the fuel storage racks ensures control of criticality. After a cooling period of 1 to 3 years (dependent on the safety requirements of the transport packages and the reprocessors' specifications), the spent fuel is shipped to Cap la Hague for reprocessing. Regular transports ensure that the fuel pool inventory is kept to a practical minimum, as required by the plant operating license.

Ad b) Spent fuel is stored in the spent fuel pool of the High Flux Reactor (HFR) of JRC at Petten, prior to being being shipped to COVRA for long-term storage or, in a limited number of cases, returned to the original supplier in the USA. The design of the fuel pools complies with the provisions in NVR publication 2.1.10, adapted from IAEA Safety Series No. 50-SG-D10. This design ensures the removal of residual heat from the spent fuel, while the design of the fuel storage racks ensures control of criticality. Usually a cooling period of five years is applied before the spent fuel is transferred to COVRA. Periodic transports are arranged to ensure that the pool always has adequate storage capacity available to accommodate all elements from the reactor core.
The HFR utilises HEU fuel.

The consumption of fuel in the Low Flux Reactor (LFR) in Petten is very low. The original fuel elements are still in use and the LFR is not discussed further in this report.

Also at the "Hoger Onderwijs Reactor" (HOR) at the Interfaculty Reactor Institute of the Technical University in Delft spent fuel is stored in the spent fuel pool. It will be transferred to the HABOG facility (the facility for treatment and storage of high level waste) at COVRA after its commissioning. In 1998 a conversion of HEU fuel to LEU fuel was started. The share of the LEU assemblies in the ^{235}U loading of the core is now more than 70%.

Ad c) Pending the completion of the construction of HABOG and prior to its commissioning, scheduled at the end of 2003, some spent fuel from the HFR in Petten is temporarily stored in Castor transport and storage casks in the storage building for low and intermediate level radioactive waste (LOG). The operation license of COVRA allows storage of maximum 12 of such spent fuel casks in the LOG. The design of the Castor casks ensures sub criticality of the spent fuel under all foreseeable circumstances. The heat generated by the spent fuel elements is so low (some tens of watts for the whole cask) that no special measures are required.

Ad d) Most of the spent fuel from the nuclear power stations has been transferred to the reprocessing plants in Sellafield and Cap la Hague and has been reprocessed in previous years. Depending on the reprocessors' operating schedule, some quantity is temporarily stored in the reprocessors' storage pools pending shearing. It is being managed under the prevailing regulatory systems in the UK and France. The radioactive residues from reprocessing activities will in due time be returned to the Netherlands and stored in the HABOG facility at COVRA.

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

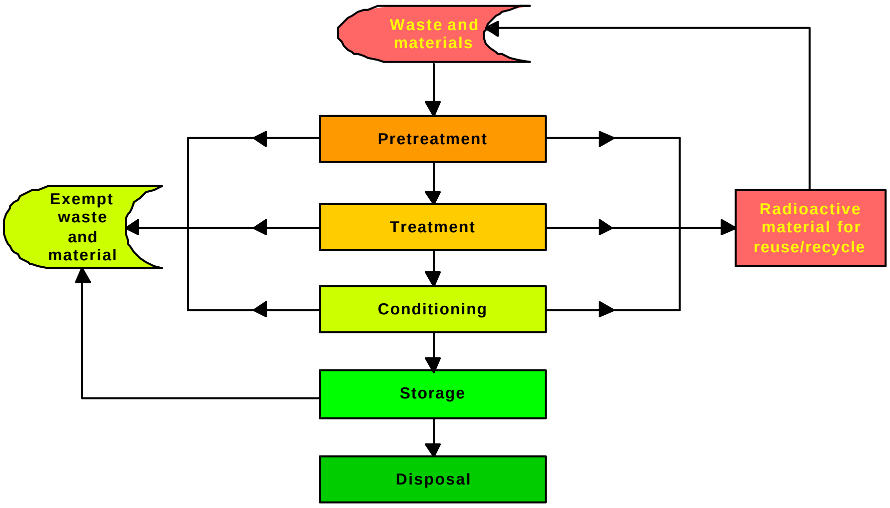
Spent nuclear fuel mentioned under d) and e) is not being managed in the Netherlands and will not be addressed further in this report.

Art 4 (ii): ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;

In the beginning of the nuclear era in the Netherlands the operators of the two NPP's Dodewaard and Borssele decided in favour of reprocessing for economic reasons. Uranium prices were relatively high and it was considered that the reprocessed uranium and plutonium could be reused either in fast breeder reactors or as MOX in the more conventional light water reactors. Reuse of resource materials is definitely a way to reduce the amount of waste if not in an absolute sense, then at least relative to the electric output of the process. However, low market prices of uranium have made the reuse of uranium and plutonium from reprocessing facilities in reactor fuel relatively expensive and, consequently, not competitive with fresh uranium. As a consequence, the stocks of plutonium and uranium have steadily increased and are kept in storage at the reprocessing facilities in the UK and France. The utility operating the Borssele plant has arranged for the recycling of its reprocessing products (uranium, plutonium); for the products of future Dodewaard fuel reprocessing, no decisions have been made as yet.

Art 4 (iii): take into account interdependencies among different steps in spent fuel management.

The basic steps in spent fuel management are not fundamentally different from those in radioactive waste management. For radioactive waste management the steps identified and internationally agreed upon are pre-treatment, treatment, conditioning, storage and disposal [1] (see scheme below).



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

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

Art 4 (iv): provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

Radiation protection of workers

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

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

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

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

The Bkse also states that these activities must be carried out by or under the responsibility of a person with sufficient expertise, subject to the judgement of the regulatory body[1]. This expert should occupy a post in the organisation such that he or she is able to advise the management in an adequate way and to intervene directly if he or she considers this to be necessary.

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

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

At the Borssele NPP an individual dose limit of 10 mSv per year has been set as an average long term objective for radiological workers. This objective serves as an internal target within the context of meeting ALARA requirements. At the other sites in the Netherlands where spent fuel is managed similar operational dose constraints have been adopted.

Radiation Protection of the Public and the Environment

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

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

Art 4 (v): take into account the biological, chemical and other hazards that may be associated with spent fuel management;

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

[1] A description of the composition and the functions of the Regulatory Body is given in the text under Article 20.

At the HFR in Petten and the IRI in Delft fuel assemblies are also transferred directly from the reactor core to the storage pool. In due course these are transported to COVRA (or to the original supplier in the USA) in certified and accident proof packages. Therefore, chemical or other hazards are not considered to be a significant issue in the context of spent fuel management.

Physical security is implemented on basis of guidelines from, and under supervision of, the Ministry of the Interior (terrorist threats, etc).

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

Art 4 (vi): strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

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

(i) Bad management of spent fuel, resulting in uncontrolled discharges into the environment at some time in the future.

(ii) Prolonged authorized discharges of long-lived radionuclides into air and water (e.g. estuaries or the sea). This could result in a gradual build-up of long-lived radionuclides in the atmosphere, causing humans to be exposed to ever increasing concentrations of radioactivity or to delayed exposure due to transportation and concentration mechanisms in foodchains which become significant only after an equilibrium situation has been reached.

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

For the spent fuel of the research reactors the same approach applies. The clear objective is to limit as far as practicable the amount of spent fuel in the storage pool at the reactor site. However, sometimes external factors have caused a departure from this policy resulting in a temporary increase of the stock of spent fuel in the storage pool. An example of this is the interruption in the possibility to return spent fuel to the fuel manufacturer in the USA in 1995 and 1996, due to the need to wait for the Record of Decision of an Environmental Impact Statement on foreign research reactor spent fuel.

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

Art 4 (vii): aim to avoid imposing undue burdens on future generations.

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

For spent fuel from the NPP's the decision has been taken to subject it to reprocessing with the aim to recover resource material from it and to immobilize the fission products into a stable glass matrix of High Level waste (HLW). The medium-level reprocessing residues will also be packed in such a way, that long-term safe and maintenance-free handling is possible. Consequently, it is envisaged that future generations will not have to be concerned with the management of spent fuel from the NPP's. The "burden" for future generations is limited to finding a final destination for the HLW, which according to prevailing expert views is already in a suitable condition for disposal.

Spent fuel from the research reactors will be conditioned, packaged and subsequently stored in the facility for the treatment and storage of high-level waste at COVRA. The care for that material will be passed on to the next generation. However, not only the burden of this care will be passed on to the next generation, but also financial resources and technical knowledge required to set favourable conditions for a good management of the spent fuel. It is also left to the judgement of the next generation whether there is any benefit in extracting the resource material from it in a later stage.

Article 5. EXISTING FACILITIES

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

The Netherlands has chosen for the option of reprocessing spent fuel from the nuclear power stations. Some spent fuel is kept in storage in the fuel pools at the reactor sites, waiting for transport to the reprocessing facilities.

Most of the spent fuel not yet sheared is kept in storage at the reprocessing plants in France and the UK, waiting for reprocessing. The management of this SF is exercised under the authority of the French and UK government respectively.

The only other spent fuel management facility is the HABOG facility, managed by COVRA. This facility is designed to store conditioned SF from the research reactors. This facility will be commissioned in 2003. In this case an upgrade of the safety of this facility is not applicable. However, under the operating license there is a condition to evaluate every 5 years the actual safety level, the operational experience and the developments in general regarding the safety of this spent fuel management facility.

Article 6. SITING OF PROPOSED FACILITIES

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

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

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

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

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

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

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

The site selection procedure for COVRA followed two separate routes. For a selection of potentially suitable locations a commission of high-ranking officials from the domain of public administration was established. The first step in the procedure was the formulation of selection criteria for the facility. The selection criteria for candidate sites for the COVRA facility were mainly based on considerations of adequate infrastructure and the site had to be situated at an industrialised area. As a matter of fact many sites comply with these rather general criteria. Twelve of these were selected by the commission as being suitable in principle. None of the investigated sites had features which were thought to be prohibitive for the planned activity. For the selection of the preferred sites the co-operation of the local authorities was sought. In order to facilitate the negotiations with the local authorities in the case of COVRA a site-independent Environmental Impact Assessment (EIA) was performed (see below). As expected, this demonstrated essentially the absence of any adverse effect on the environment. However, this conclusion did not lead to an offer from local administrators. Although there are in principle legal procedures for overruling a refusal by a local or regional authority to accept a potentially suitable storage or disposal site, as a rule the consensus model is followed for the allocation of a site. In practice this limits the number of available sites to just a few, since most municipalities consider the presence of a radioactive waste management facility as undesirable unless they are compensated generously for the inconvenience. Consequently, the preferred sites are basically selected on the basis of willingness of local authorities to co-operate in the establishment of such a facility. Only two municipalities were willing to accommodate a facility for storage of spent fuel and radioactive waste. COVRA expressed a proference for the present location in the Sloe industrial area in the South-West part of the country close to the NPP Borssele.

As mentioned earlier, the second route towards the selection of a site was an assessment of the possible environmental effects from a spent fuel and waste storage facility for a generic site. The Environmental Impact Statement was published in 1985. The EIS was re-written for the specific location in the Sloe area and submitted as part of the license application to the competent authority. This location-dependent Environmental Impact Assessment (EIA) was performed by considering three operational alternatives (the proposed facility, a facility with maximum volume reduction and a facility with a maximum reduction of handling operations). Both the EIS and the license application were made available to the public for comment. A scheme with the comprehensive step-wise decision-making process for an EIA is presented at the text under article 8.

Art. 6.2 In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.

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

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

Article 7. DESIGN AND CONSTRUCTION OF FACILITIES

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

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

Spent fuel from the research reactors is due to be stored in the HABOG facility at COVRA. HABOG is currently under construction and is expected to come into operation in 2003. A schematic cross-section of the HABOG facility is presented in Figure 1.

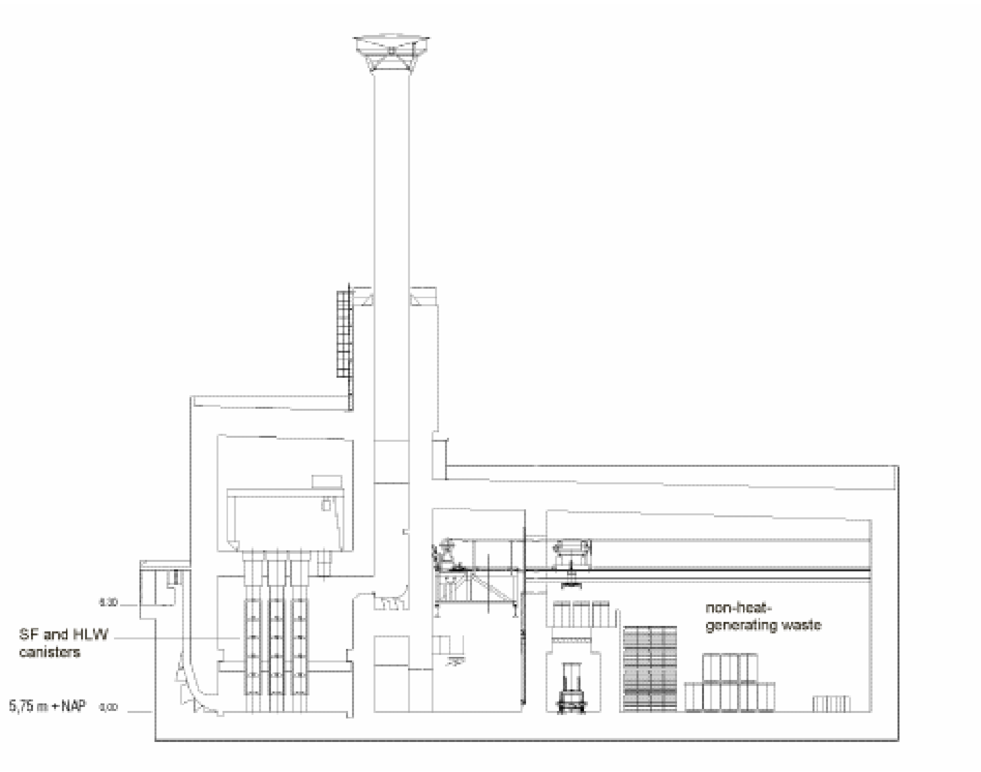


Figure 1   Cross-section of the HABOG facility

The HABOG is a vault type storage facility divided in two separate compartments: one for the storage of drums and other packages containing cemented and bituminous waste (hulls and ends and other high level radioactive waste) and one for the storage of vitrified HLW from reprocessed SF originating from the NPP's and for unreprocessed SF originating from the research reactors. The first category does not require additional cooling, the second category does. SF and vitrified HLW are stacked on 5 levels in vertical air-cooled storage wells. The storage wells are filled with an inert gas to prevent corrosion of the canisters and equipped with a double jacket to allow passage of cooling air. The double jacket ensures that there is never direct contact between SF - or waste canisters with the cooling air. The air cooling system is based on the natural convection concept. A schematic diagram of the storage compartment for SF and vitrified HLW is represented in Figure 2.

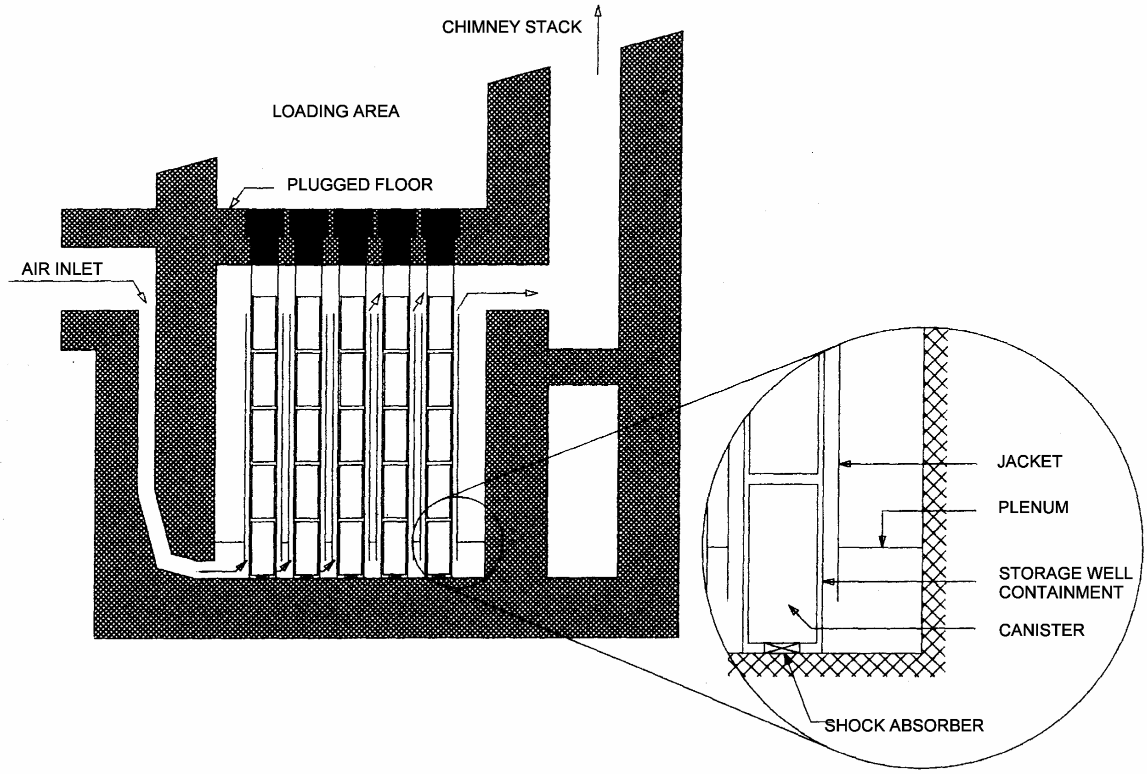


Figure 2 Storage wells for SF and HLW in the HABOG

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

- Isolation
- Control
- Monitoring

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

Isolation:

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

Control

- Assurance of a condition of sub-criticality of the SF by application of neutron absorbers and by a suitable geometry of the SF.
- Assurance of adequate cooling of heat-generating HLW.
- Possibility to move SF or HLW from the storage wells with a view to repackaging, relocating to another storage compartment or removal from the facility.

Monitoring

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

These requirements have been implemented in the following ways:

Isolation:

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

Control

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

Monitoring

- The ventilation system is composed of two separate systems: a passive system, based on natural air convection (SF and HLW requiring cooling) and a mechanical system (other HLW). In the former system the ventilation air is never in contact with any radioactive material or contaminated surfaces and is, consequently, not monitored. In the latter system the ventilation air is passed over filters before being released through the chimney stack. This system is designed in such a way that the air flows from areas with no or low contamination to areas with a potentially higher contamination.

Art 7 (ii): at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

The SF and HLW storage facility HABOG is designed for a storage period of at least 100 years. Since the technologies are likely to change considerably in this period, no firm plans for decommissioning have been made. Moreover, the places in the HABOG which may become contaminated with radioactive material due to handling of the management of SF/HLW are limited. The finishing of all surfaces in places where radioactive material is being handled is carried out in such a way that any radioactive contamination can be easily removed. Consequently, it is unlikely that major structures and components of the building become contaminated

Art 7 (iii): the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

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

Article 8. ASSESSMENT OF SAFETY OF FACILITIES

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

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

A license for a spent fuel management facility is only granted if the applicant complies with the national requirements and, more in general, with international (IAEA) established safety goals, codes and guides, as well with the international state of the art. Also the applicable parts of the IAEA codes on Design, Operation and Quality Assurance for NPP's must be covered or incorporated in the Safety Report (SR), which is submitted to the regulatory body. A typical example are the requirements against the site specific external hazards, such as military aircraft crashes, external flooding, seismic and gas cloud explosions.

After obtaining the license but before construction the licensee drafts and submits to the regulatory body the Safety Analysis Report (SAR) and supporting topical reports, which give a detailed description of the facility and present an in-depth analysis of the way in which the facility meets the SR and the international state of the art.

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

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

The regulatory body closely follows the HABOG project. Selected items or documents in the SAR are studied in more depth, often using assessment by independent organizations. These key documents are submitted to the regulatory body for approval. Other documents are submitted for information only.

The commissioning of the HABOG facility is presently in its final stage.

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

In the Environmental Impact Assessment Decree[2], which is based on the EU Council Directive 97/11/EC on "Assessment of the effects of certain public and private projects on the environment", spent fuel and radioactive waste management facilities are designated as activities which are subject to the Decree. An Environmental Impact Statement is always mandatory in the following cases:

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

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

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

Although strictly speaking the following example is not applying to SF management operations, because these were not operational at the time, it can still be considered as representative.
With a view to monitor whether the predicted favourable outcome of these statements could be confirmed in practice an evaluation was made of the health and environmental effects in 1995 after 3 years of operation of the facility for low and intermediate level radioactive waste.

It appeared that the impact to the environment was even lower than assumed in the EIS, because all emissions of radioactive materials and chemical hazardous materials – both airborne and waterborne – remained far below the limits authorized in the operating license. The annual reports of COVRA on releases and radiation levels at the fence of the facility show that this favourable situation continues.

A detailed scheme of all steps in the EIA procedure is presented in Figure 3.

Article 9. OPERATION OF FACILITIES

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

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

After the commissioning of the SF/HLW storage building the licensee submits the report with description of the as built-facility and the results of the commissioning to the regulatory body for approval before start of the routine operation. This document shall demonstrate full compliance with the license and the SR. Non-compliance with more detailed design requirements shall be discussed with the regulatory body for approval. The results of the commissioning programme are incorporated in a full update of the SAR. This final SAR shall be submitted for approval to the regulatory body.

During the first operational phase, when the storage building is accepting its SF and HLW, the regulatory body shall closely follow the safety of the installation by by inspections and assessment of the licensee's periodic operation reports.

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

According to Article 15, sub b of the Nuclear Energy Act licenses are required for building, taking into operation and operating a nuclear installation. In the specific case of a spent fuel and radioactive waste management facility these licenses are usually granted by one ministerial decision. The issue of a license is conditional on a favourable outcome of the review of the safety assessment of the facility by the Nuclear Safety Department of the Ministry of Housing, Spatial Planning and the Environment and on a favourable outcome of the EIS.

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

Art. 9 (ii): operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;

The license conditions for the operator, which are attached to and form a constituent part of the operating license, specify the obligations which the operator has to meet. Some of these license conditions form the basis for the establishment of operational limits which ensure that under foreseeable circumstances the authorized limits, as set by the licence, will not be exceeded. Other license conditions demand that periodic reviews be carried out with the aim to assess whether the assumptions, which form the basis of the safety assessment of the facility, are still valid. The results of these periodic reviews are submitted to the Regulatory Body for further evaluation. When deemed necessary a revision of the operational limits will be undertaken.

Figure3. General scheme of the E.I.A.-procedure in the Netherlands

Time limits (weeks)	Environmental Impact Assessment	What happens?
M	Inception memorandum (EIA)	The proponent presents the inception memorandum (also called: notification of intent or starting note) with a brief description of the proposed activity. The competent authority makes the memorandum public. The procedure begins.
4	Public participation comment and advising	In a public participation period of 4 weeks, the public and the advisers comment and advise on the memorandum to the competent authority. This participation and advising aims at the guidelines for the contents of the EIS. The advice of the EIA Commission on the guidelines is especially important.
13	Guidelines	13 weeks after the publication of the inception memorandum the competent authority draws up the guidelines. The guidelines define the environmental effects and alternatives to be assessed in the Environmental Impact Statement.
M	Production of the Environmental Impact Statement (EIS)	The proponent is responsible for drawing up the Environmental Impact. Statement There is no maximum time limit. In this phase an intensive interaction between the EIS process and the development of the project or plan is recommended. As soon as the EIS is ready, the proponent sends it with the license application or draft plan to the competent authority.
6	Acceptation of the Environmental Impact Statement	The competent authority checks the Environmental Impact Statement on the basis of the guidelines and legal requirements within 6 weeks.
8	Publication of the Environmental Impact Statement and license application for the draft plan	The competent authority publishes the Environmental Impact Statement within 8 weeks after receiving it. The EIS is published simultaneously with the license application for public comment and advising. An EIS for a plan is published together with the draft plan.
4	Public participation, advising and hearing	The public and the advisers give their comments on the Environmental Impact Statement and on the license application or draft plan. The public participation period is at least 4 weeks. A hearing is included.
5	Review of the Environmental Impact Statement by the EIA Commission	Within 5 weeks after the public participation period, the EIA Commission reviews the EIS both for completeness and scientific quality, taking into account the comments from the advisers and public participation.
	Decision	The competent authority decides on the basis of the EIS and the received comments and advice. It motivates in the decision how the EIS (impacts and alternatives) and comments were taken into account. The competent authority must also formulate an evaluation programme.
	Evaluation	In cooperation with the proponent, the competent authority evaluates the environmental impacts on the basis of the evaluation programme. If necessary, the competent authority may order extra mitigating measures to reduce the environmental effects.

Art. 9 (iii): operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;

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

Examples of such license conditions include:

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

Art. 9 (iv): engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;

The specific policy in the Netherlands requires long term planning for COVRA's activities. For the HABOG facility an active operating phase is foreseen that will last until 2014, which was based on the assumption of a shut-down in 2003. This date will change, however, if the operational life of the NPP at Borssele is significantly extended, and more HLW will be generated. During this active period waste will be accepted and actively stored in the facility. From 2015 until 2130 (design basis ~100 years) the facility will be in its passive phase. No new waste will be brought into the building. Only maintenance and control will take place. After 2130 a final disposal route should become operational. The money needed for this passive period (as well as for the disposal) will be paid in advance and is calculated as discounted value. The money is put in a capital growth fund. When the money is available support can be purchased.

Art. 9 (v): incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

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

Art. 9 (vi): programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

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

Art. 9 (vii): decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

As set out under Article 7 (ii), there are at the moment no decommissioning plans for the SF/HLW storage facility, because of the anticipated long storage period.

Article 10. DISPOSAL OF SPENT FUEL

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

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

CHAPTER 3 SAFETY OF RADIOACTIVE WASTE MANAGEMENT

Article 11. GENERAL SAFETY REQUIREMENTS

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

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

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

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

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

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

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

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

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

See the text under Article 4.

Article 12. EXISTING FACILITIES AND PAST PRACTICES

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

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

The only existing radioactive waste management facility in the Netherlands is the COVRA waste treatment and storage facilityat Borsele. It consists of an operational waste treatment and waste storage facility for low and intermediate level radioactive waste and a treatment and storage facility for HLW and SF (HABOG). On the premises of COVRA a building was also constructed for the storage of NORM waste, in cases where the regulatory exemption limits are exceeded. Another building is designed for the storage of depleted uranium oxide from the Urenco enrichment plant in Almelo. The LILW facility is equipped with volume-reducing installations including a 1500 ton supercompactor, an incinerator for liquid organic waste and an incinerator for animal carcasses. The LILW facility has now been in operation for more than 10 years. The whole waste management facility got a major regulatory overhaul in the framework of a revision of the license for the construction and operation of the HABOG.

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

Pending the commisioning of the HABOG facility at COVRA 1,500 drums of waste are stored at the NRG Waste Storage Facility at Petten. This waste, resulting from some four decades of nuclear research at that facility, includes some highly active waste containing fuel material residues and some highly active wastes not including fuel material (fission and activation products). The wastes are stored in metal drums placed inside concrete-lined pipes ("storage tubes").

In the course of a two-year campaign between 1999 and 2001 the waste was inspected and levels of activity were determined. The inspection revealed evidence of corrosion in drums containing highly active mixed waste, due to the presence of PVC. It is intended that those drums containing PVC, about 300 in total, will be treated and repacked using a hot cell facility currently under construction at the Petten plant. This facility is scheduled for completion during 2004. Prior to the inspection campaign, the potential implications of packaging highly active waste together with PVC were unknown and this practice no longer occurs.

The majority of containers, i.e. those not requiring treatment and repackaging, will be moved to HABOG over a three-year period beginning in 2004. After this is completed, the remainder will also be transported to the HABOG facility. It is intended that all historical waste from the Waste Storage Facility at Petten will have been removed by 2009.

Article 13. SITING OF PROPOSED FACILITIES

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

- **(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;**
- **(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;**
- **(iii) to make information on the safety of such a facility available to members of the public;**
- **(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.**

2 In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other

Contracting Parties by being sited in accordance with the general safety requirements of Article 11.

See text under Article 6.

Article 14. DESIGN AND CONSTRUCTION OF FACILITIES

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

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

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

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

Normal operation

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

Vials containing scintillation liquid

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

Liquid waste

Unless their composition is exactly known liquids are considered as mixtures of organic and inorganic components. Liquids are subjected to several pre-treatment steps aimed at separating the organic and solid components. Further treatment takes place in the water treatment system where as far as possible the dissolved radioactive material is deposited with chemical agents. Usually the radioactivity concentrates in the deposit and can be separated by filtration. The purified aqueous liquid is then almost free of contamination and can be discharged within the authorized limits. The radioactive residue is again conditioned with cement grout.

Animal carcasses

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

Compactable waste

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

Sources and other waste

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

Storage buildings (LOG, COG and VOG)

The buildings for the storage of conditioned radioactive waste (LOG) are robust concrete buildings with floors capable of carrying the heavy load of drums stacked in 9 layers (see also Appendix 2). The moisture content in the air of the LOG is controlled to prevent condensation and thus corrosion of the metal surfaces of the stored drums.

In the COG building containers with large volumes of TENORM from the phosphor producing industry are stored. The building is constructed of light-weight materials in view of the relatively low radiation levels of the waste.

In the VOG building depleted uranium from the uranium enrichment plant in the form of uranium oxide (U_3O_8) is stored in small containers. A concrete structure is needed in order to obtain the required shielding.

Accidents and Incidents

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

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

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

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

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

See the text under Article 7. (ii).

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

In 1993 the government adopted a position paper [3] on the long-term underground disposal of radioactive and other highly toxic wastes, which was presented to parliament, and which now forms the basis for the further development of a national radioactive waste management policy: any underground disposal facility to be constructed shall be designed in such a way that each single step in the process can be reversed. The consequence of this position is that retrieval of the waste, if deemed necessary for whatever reason, is always possible.

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

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

There might be some conflict between the requirement of retrievability and the requirement to prepare technical provisions for closing a disposal facility. While retrievability demands accessibility of the waste in a repository for a prolonged period – until adequate assurance has been obtained that there are no adverse effects associated with underground disposal, or that no more advanced processing methods for the waste have become available – safety requires that the repository is closed as soon as all the waste is emplaced, in order to create an effective barrier from the biosphere. In practice the feasibility of keeping a geological repository accessible for retrieval purposes is restricted to a maximum of a couple of hundred years, depending on the type of host rock [4]. While borehole convergence due to plastic deformation of the host rock is rather limited for granite, repositories in salt and clay, without any supportive measures of the galleries, tend to close around the emplaced waste. Basically in safety studies this plastic behaviour of salt and clay has been advocated as a safety asset because of an enhancement of the containment function of the repository and a facilitation of the heat dissipation to the rock formation. Consequently, the retrieval period should be limited to a realistic length of time. In the Netherlands only salt and clay are available as possible host rock for an underground disposal facility.

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

Since the Netherlands has adopted the strategy of long-term storage (at least 100 years, see also Appendix 2) in dedicated buildings at the surface, there is no immediate urgency to resolve this matter in the next decade.

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

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

Article 15. ASSESSMENT OF SAFETY OF FACILITIES

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

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

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

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

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

Article 16. OPERATION OF FACILITIES

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

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

See text under Article 9 (i).

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

See text under Article 9 (ii).

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

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

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

See text under Article 9 (iv).

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

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

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

During treatment and conditioning the categories are kept separate.

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

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

See text under Article 9 (v).

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

See text under Article 9 (vi).

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

See text under Article 9 (vi).

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

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

Article 17. INSTITUTIONAL MEASURES AFTER CLOSURE

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

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

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

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

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

CHAPTER 4 GENERAL SAFETY PROVISIONS

Article 18. IMPLEMENTING MEASURES

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

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

Article 19. LEGISLATIVE AND REGULATORY FRAMEWORK

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.

a. Overview of the legal framework

The following are the main laws to which nuclear installations are subject:

- the Nuclear Energy Act (1963, as amended 2002); (Kernenergiewet, Kew);
- the Environmental Protection Act (1979, as amended 2002);(Wet milieubeheer, Wm);
- General Administrative Law Act (1992, as amended 2003) (Algemene wet bestuursrecht, Awb).

The basic legislation governing nuclear activities is contained in the **Nuclear Energy Act**. The Nuclear Energy Act has historically been designed to encourage the use of nuclear energy and radioactive techniques, as well as to lay down rules for protection of the public and workers against the risks. The Act sets out the basic rules on nuclear energy, makes provisions for radiation protection, designates the various competent authorities and outlines their responsibilities.

Licences for nuclear facilities are granted jointly by the Minister of Housing, Spatial Planning and the Environment, the Minister of Economic Affairs, and the Minister of Social Affairs and Employment (plus, where relevant, some other ministers whose departments may be involved). Together, these ministers form the competent authorities as defined by the Nuclear Energy Act and are jointly responsible for assessing the licence applications and granting the licences. The Minister of Housing, Spatial Planning and the Environment acts as the co-ordinator. The powers and responsibilities of the various ministers are described in more detail in the section on Article 19.2 (ii) of this Convention.

With regard to nuclear energy, the purpose of the Act is to regulate (Article 15b):

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

- the observance of international obligations.

A number of decrees have also been issued containing additional regulations. The most important of these in relation to the safety aspects of nuclear installations are:

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

The Nuclear Installations, Fissionable Materials and Ores Decree regulates all activities (including licensing) that involve fissionable materials and nuclear installations. The Radiation Protection Decree regulates the protection of the public 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 use.

The Nuclear Energy Act and the above mentioned decrees are fully in compliance with the relevant Euratom Directive laying down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. The implementation of the latest version of this Directive (96/29/Euratom) in the relevant Dutch regulations has been completed in 2002 by the entry into force of a revision of the Radiation Protection Decree.

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

Normally (i.e. for non-nuclear installations) this Act regulates all conventional environmental issues (e.g. chemical substances, stench and noise), but in cases concerning nuclear installations the Nuclear Energy Act takes precedence and regulates also the aspects of such conventional environmental issues.

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

For additional information see also the text under Article 4 (iv).

b. Main elements of the Acts and Decrees

b.1 Nuclear Energy Act (Kew)

As far as nuclear installations are concerned, the Nuclear Energy Act covers three distinct aspects of the handling of fissionable materials and ores, i.e. the registration thereof, the transport and management of such materials and the operation of sites at which these materials are stored, used or processed.

In the framework of the Nuclear Energy Act fissionable materials are defined as materials containing uranium, plutonium or thorium to a certain percentage (i.e. 0.1% uranium or plutonium and 3% thorium by weight) and destined for use in the nuclear fuel cycle. All other materials are defined as radioactive materials.

(a) The registration of fissionable materials and ores is regulated in Articles 13 and 14 of the Nuclear Energy Act; further details are given in a special decree issued on 8 October

1969 (Bulletin of Acts and Decrees 471). The rules included in the legislation impose a reporting requirement under which notice must be given of the presence of stocks of fissionable materials and ores. The Minister of Economic Affairs has decided that the Central Import and Export Office should be responsible for maintaining the register and that the Economic Investigation Service should act as the supervisory authority in this connection.

(b) A licence is required in order to transport, import, export, be in possession of or dispose of fissionable materials and ores. This is specified in Article 15, sub a of the Act. The licensing requirements apply to each specific activity mentioned here. The Nuclear Installations, Fissionable Materials and Ores Decree of 4 September 1969 (Government Gazette 403, last amended on 8 July 2002, Government Gazette 407) sets out additional regulations in relation to a number of areas, including the procedure for applying for a licence. Furthermore, a licence is normally subject to certain conditions relating to safety, public health, the health of workers and the environment. An exhaustive list of the areas which may be covered by such conditions is given in Article 15b of the Nuclear Energy Act. In practice these licences are granted on a fairly regular basis, mainly because of the large number of international transports that pass through Dutch territory.

(c) Licences are also required for building, operating and decommissioning nuclear installations (Article 15, sub b), as well as for using vessels powered by nuclear energy (Article 15, sub c). Up to date the latter category has not been of any practical significance.

Licences for nuclear installations are issued under the joint responsibility of the Minister of Housing, Spatial Planning and the Environment, the Minister of Economic Affairs and the Minister of Social Affairs and Employment (plus other ministers, where relevant).

The Nuclear Energy Act distinguishes between construction licences and operating licences. In theory, a license for building a SF management facility or a radioactive waste management facility may be issued separately from any licence for actually operating the facility in question. However, the construction of a facility involves much more than simply building work. Account must be taken of all activities which are to be performed in the facility, which means that the government needs to decide whether the location, design and construction of the facility are such as to afford sufficient protection from any danger, damage or nuisance associated with the activities to be performed there. In practice, therefore, the procedure for issuing a licence for operating a facility will be of only limited scope, unless major differences have arisen between the beginning and the completion of construction work. Consequently, usually a combined license for construction and operation is issued.

A licence is also required for modifications to a facility, if such modifications result in a description of the facility, which departs from the one submitted at the time of the original application.

The decommissioning of nuclear installations is regarded as a special form of making modifications and is treated in a similar way.

In cases where very minor modifications are at stake, the licensee may make use of a special provision in the Act (Article 18) that allows such modifications within the existing licence. In these cases the licensee only has to submit a report describing the foreseen modification. This reporting system can only be used if the consequences of the modification for man and environment are within the limits of the licence in force. If the modification fulfils these conditions, the Regulatory Authority will accept the report. From that moment onwards the modification is to be considered as part of the license.

The licensing requirements relating to nuclear facilities as referred to in the Convention are also set out in the Nuclear Installations, Fissionable Materials and Ores Decree referred to above. Under Article 7 of this Decree (and/or Article 44 of the radiation Protection Decree for a radioactive waste management facility), applicants are required to supply the following information when applying for a licence:

- a description of the site where the facility is to be located, including a statement of all relevant geographical, geological, climatological and other conditions;
- a description of the facility, including the equipment to be used in it, the mode of operation of the facility and the equipment, including a list of the names of the suppliers of those components which have a bearing on the assessment of the safety aspects;
- 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 facility, specifying the maximum quantities of the various fissionable materials that will be present in the facility at any time;
- a description of the way in which the applicant intends to dispose of the relevant fissionable materials after their use;
- a description of the measures which are to be taken either by or on behalf of the applicant so as to protect people, animals, plants and property, including measures to prevent any danger, damage or nuisance from being 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 that would be caused outside the installation as a result of those events (Safety Analysis Report);
- a risk analysis concerning the harm or detriment caused outside the installation as a result of severe accidents (Probabilistic Safety Analyses);
- a global description of the eventual decommissioning foreseen and the way this decommissioning will financed.

In addition to these regulations concerning the handling of fissionable materials, the Nuclear Energy Act covers in a separate chapter (Chapter VI) also intervention and emergency planning and response.

b.2 Environmental Protection Act (Wm)

In compliance with this Act and the Environmental Impact Assessment Decree, the construction of a nuclear facility requires the drafting of an environmental impact assessment as part of the licensing procedure. In certain circumstances, an environmental impact assessment is also required if an existing facility is modified. More specifically, it is needed in cases where the activity relates to:

1. an increase in the treatment capacity for irradiated nuclear fuel or high-level radioactive waste by more than 50%, or

2. an increase in the total storage capacity by more than 50% or by more than 10,000 cubic metres.

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

The public and interest groups often use environmental impact assessments as a means of commenting on and raising objections to decisions on nuclear activities. This clearly demonstrates the value of these documents for public debate and involvement.

b.3 General Administrative Law Act (Awb)

Appeals procedure

Notice must be given, both in the Government Gazette and in the national and local press, of the publication of a draft decree under which a licence is to be awarded to a facility as defined by the Convention. At the same time, copies of the draft decree and of the documents submitted by the applicant must be made available for inspection by the general public. All members of the public are free to lodge a written objection to the draft decree and to ask for a hearing to be held under the terms of the General Administrative Law Act. Account is taken of the objections made to the draft version of the decree when the final version is drawn up. Anybody who has objected to the draft decree is free to appeal to an administrative court (i.e. the Council of State, Administrative Justice Division) against the decree under which the licence has been granted, amended or withdrawn. If the appellant asks the court at the same time for provisional relief (i.e. a suspension of the licence), the decree (i.e. the licence) does not take effect until the court has reached a decision in that request for suspension.

Article 19.2: This legislative and regulatory framework shall provide for:

(i) the establishment of applicable national safety requirements and regulations for radiation safety;

The Nuclear Energy Act provides for a system of general goal oriented rules and regulations. For spent fuel and radioactive waste management facilities few specific rules exist. One of the legal documents in which radioactive waste is specifically mentioned is Article 37 of the Radiation Protection Decree [5], which stipulates that an authorized user of radioactive material is allowed to dispose of radioactive material without a license in only a limited number of ways:

- if not declared as waste:
  - if the activity or the activity concentration is below the exemption/clearance levels, as applicable;
  - in the case of sealed sources, if return of the source to the manufacturer or supplier of the source is possible;
  - by transfer to another individual or legal person for use, reuse or recycling of this radioactive material or for collection and pre-treatment of radioactive waste, provided that this person holds a valid license for this material;
- if declared as waste:

- by transfer to a recognised waste management organisation. COVRA is the only recognized organisation for the collection, treatment and storage of radioactive waste [6];
- by transfer to another designated organisation for the collection of radioactive waste.

For all practical purposes, licensees for applications of radioactive materials are required to deliver their radioactive waste or fissionable materials for which no further use is foreseen or spent fuel which is not destined for reprocessing, to COVRA as the centralised waste management organisation. The underlying philosophy is that, because of the relatively small amounts of waste to be managed, only a centralised approach can ensure an adequate level of professionalism in the management of the waste.

As has been outlined in the text under Article 19.1, the operations in the spent fuel and radioactive waste management facilities of COVRA are essentially governed by two decrees for the safety aspects:

- the Nuclear Installations, Fissionable Materials and Ores Decree [7](Bkse), and
- the Radiation Protection Decree (Bs).

These decrees set the following criteria:

Normal operation

- A maximum total individual dose of 1 mSv in any year for the consequences of normal operation of all artificial sources emitting ionising radiation (i.e. NPPs, isotope laboratories, sealed sources, X-ray machines, etc.).
- For a single source (for instance a waste management facility), the maximum individual dose has been set at 0.1 mSv per year. As a first optimisation goal, a dose level of 0.04 mSv per year has been set for a single source in accordance with the ALARA principle.

Design base accidents

- The risks due to accidents for which protection is included in the design of the facility, i.e. the design base accidents, should be lower than the values in the table below:

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

Non-compliance with the values in the table is a reason for refusing a license.

Incidents and accidents

- In accordance with the Dutch policy on the tolerability of risk, the maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per year for all sources together and 10^{-6} per year for a single source.
- Where severe accidents are concerned, not only the individual mortality risk must be considered but also the group risk (societal risk). In order to avoid large-scale disruption to society, the probability of an accident in which at least 10 people suffer acute death is restricted to a level of 10^{-5} per year. If the number of fatalities increases by the factor of n, the probability should decrease by a factor of n^2. Acute death means death within a few weeks; long-term effects are not included in the group risk.

Art. 19.2 (ii): a system of licensing of spent fuel and radioactive waste management activities;

Art. 19.2 (iii): a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence;

As was discussed in the section on Article 7.1 of the Convention, the Nuclear Energy Act stipulates (in Article 15, sub b) that a licence must be obtained for constructing, commissioning, operating, modifying or decommissioning a nuclear facility. Similarly, the Nuclear Energy Act also states (in Article 15, sub a) that a licence is required for importing, exporting, possessing and disposing of fissionable material.

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

Article 15a of the Nuclear Energy Act lists the ministers who are responsible for licensing. As was already mentioned in the section on Article 7.1, responsibility for nuclear activities is not centralised, but is divided among a number of ministers who consult each other and also issue regulations jointly, as required, in accordance with their area of competence. The subdivision of responsibilities is as follows:

- the Minister of Housing, Spatial Planning and the Environment (VROM) is responsible, together with the Minister of Economic Affairs (EZ) and the Minister of Social Affairs and Employment (SZW), for licensing nuclear installations and activities;
- the Minister of Housing, Spatial Planning and the Environment is responsible, together with the Minister of Social Affairs and Employment for licensing the use of radioactive materials and radiation-emitting devices;
- the Minister of Housing, Spatial Planning and the Environment is responsible for all public health and safety aspects, including radiation protection of members of the public. The Minister of Economic Affairs is responsible for energy supply policy, the Minister of Social Affairs and Employment is responsible for radiation protection at places of work.

Other ministers may be consulted on nuclear activities which fall within their particular sphere of competence; for instance, discharges of radioactive material in air and water involve the Minister of Agriculture, Nature Management and Fisheries (LNV), and the

Minister of Transport, Public Works and Water Management (V&W). The subject of emergency response also involves these two Ministers as well as the Minister of the Interior (BZK) and the Minister of Health, Welfare and Sport (VWS). See the table below for an overview.

	LNV	V&W	BZK	VWS
Discharges in air	X			
Discharges in water	X	X		
Transport		X		
Emergency provisions	X	X	X	X
Medical applications				X

Under the terms of the Public Health Act, a Public Health Council exists to advise the ministers on issues concerning radiation protection and public health.

The first three ministers mentioned above are also the competent ministers for the suspension or withdrawal of a licence.

Article 15b of the Nuclear Energy Act enumerates the interests for the protection of which a licence may be refused (listed above in the section on Article 7.1, sub a). The licence itself lists the restrictions and conditions that apply so as to take account of these interests. The licence conditions may include an obligation to satisfy further requirements, related to the subject of the licence condition, as set by the competent regulatory body.

As stated before (see section on Article 7.1, sub b.1) in cases where very minor modifications are at stake, the licensee may make use of a special provision in the Act (Article 18) that allows such modifications without a licence. In these cases the licensee only has to submit a report describing the foreseen modification. This reporting system can only be used if the consequences of the modification for man and environment are within the limits of the licence in force.

The regulatory body conducts regular reviews to establish whether the restrictions and conditions under which a licence has been granted are still sufficient to protect the public and the environment, taking account of any developments in nuclear safety that have taken place in the meantime. Should one of these reviews indicate that, given the developments, the level of protection can and should be improved, the regulatory body will amend the restrictions and conditions accordingly. It should be noted that this is not the same as the periodic safety evaluations which the *licensee* is required to perform.

Art. 19.2 (iv): a system of appropriate institutional control, regulatory inspection and documentation and reporting;

Article 58 of the Nuclear Energy Act states that the ministers who are responsible for licensing procedures should entrust designated officials with the task of inspection and enforcement. The Decree on Inspection and Enforcement of the Nuclear Energy Act also identifies certain bodies that should be given responsibilities in this connection. The main body for inspection and assessment is the Inspectorate of the Ministry of Housing, Spatial Planning and the Environment (VROM Inspection). For safety assessments of nuclear installations, including spent fuel and radioactive waste management facilities, as well as for the radiation protection aspects, the Nuclear Safety Department (KFD) is the responsible body. One of the Directorates at this ministry is also responsible for assessing whether the radiological safety objectives have been met; this is the Directorate for Chemicals, Waste, Radiation Protection (SAS). It should be noted that this Directorate is responsible for licensing, and not for performing inspections.

Finally, the VROM Inspection, Regional Inspectorate for the Environment - Southwest Region (VI-ZW) is charged with the responsibility of assuring compliance with all non-nuclear aspects associated with nuclear facilities and with the enforcement of radiation protection and environmental regulations in non-nuclear fuel cycle related industries.

Nuclear security and safeguards are areas, which have recently been placed under the responsibility of the Ministry of VROM. The inspection tasks associated with these areas are exercised by the Nuclear Security and Safeguards Section of the KFD. Further information is given in the section on Article 20 of this Convention.

Regulatory assessment

The regulatory assessment process is as follows: the regulatory body reviews and assesses the documentation submitted by the applicant. This might be the Environmental Impact Assessment Report and Safety Report with underlying safety analyses within the framework of a licence renewal or modification request, proposals for design changes, changes to Technical Specifications, etc.

Regulatory inspection

The function of regulatory inspections is:

- to check that the licensee is acting in compliance with the regulations and conditions set out in the licence;
- to report any violation of the licence conditions and if necessary initiate remedial actions;
- to check that the licensee is carrying out all of its activities according its Quality Assurance system;
- to check that the licensee is carrying out all of its activities according the best technical means and/or worldwide accepted standards.

The check that the licensee is acting in compliance with the Nuclear Energy Act, the licence and the associated safety report is based on a system of inspections, audits with supplementary international missions, assessment of operational month reports, and evaluation of operational occurrences and incidents. An important piece of information for inspection is the five-yearly safety evaluation report. In this report the licensee presents its self-assessment of all the relevant technical, organisational, personnel and administrative matters. Every ten years a major assessment of the accomplishments in the area of safety and radiation protection is performed by the staff of the spent fuel and radioactive waste management facility and compared with new developments.

The management of inspection is supported by a yearly planning, the reporting of the inspections and the follow-up actions. On an annual basis a management meeting between the facility and KFD is held purely devoted to inspections and inspection findings.

Art. 19.2 (v): the enforcement of applicable regulations and of the terms of the licences;

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

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

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

Art. 19.2 (v): a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

The constituent parts of the Regulatory Body, which have a function in one or more steps in spent fuel and radioactive waste management are listed in the table below together with their respective responsibilities.

Ministry	**Regulatory body**	**Responsibility**	**Specific step in sf and raw management**
Housing, Spatial Planning and the Environment (VROM)	Directorate of Chemicals, Waste, Radiation Protection (SAS)	• Setting policies, developing regulations and issuing licenses; • Making technical assessments in a limited number of areas.	• Pre-treatment, treatment, storage, transport, disposal

VROM	VROM-Inspection/Nuclear Safety Department (KFD)	• Making technical assessments for all issues related to nuclear facilities; • Performing inspections and enforcement in nuclear facilities.	• Pre-treatment, treatment, storage, transport
VROM	VROM-Inspection/Nuclear Safety Department (KFD)/ Nuclear Security and Safeguards Section	• Carrying out tasks in the area of security and physical protection	• Storage, transport, disposal
VROM	VROM-Inspection/ Regional Inspection, South-West region (VI-ZW)	• Performing inspections on non-nuclear issues in nuclear facilities • Performing inspections on radiation protection and environmental regulations in non-nuclear fuel cycle related industries	• Pre-treatment by licensees other than a sf/raw management facility
VROM	VROM-Inspection/ Department on Emergency Response (CM)	• Preparing and co-ordinating actions in case of emergencies	• all
Ministry of Social Affairs and Employment;	Directorate for Safety and Health at Work	• Occupational Safety related to nuclear power generation and other applications of radiation.	• all
Ministry of Economic Affairs	Directorate for Energy Production	• Energy security	• all

Art. 19.3: When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

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

- In principle, the generation of waste is undesirable from the point of view of sustainable development (integrated life-cycle management). Waste is the result of an imperfect process. Consequently, the generation of waste should be prevented. Realising that most processes have already been optimised in previous decades for economic reasons, it is more realistic to state that generation of waste should be minimised.

- If it is not possible to further reduce the amount of waste in a process, attempts should be directed to return the waste into the process by product reuse or by materials reuse (recycling).

- If reuse or recycling cannot be achieved, or if it can only be achieved under adverse environmental conditions, incineration should be considered in order to benefit from the heat of the combustion process.

- Disposal is the last resort in case all previous options have been exhausted. For highly toxic waste such as high level radioactive waste it is advocated that such waste be stored until more advanced processing technologies become available.

- Long-term disposal must be arranged for existing waste and for future waste if arising of this waste cannot be prevented. The disposal facility should be constructed in such a way that the waste is not only retrievable but that in principle the whole disposal process can be reversed. This requirement is imposed firstly with the aim to maintain control over the waste and secondly to ensure that the waste remains accessible for purposes of re-entering it into the cycle when such an opportunity arises provided that this can be done in an environmentally responsible manner.
- While recognising that existing salt and clay formations in the deep underground provide a good natural isolation of the waste, a disposal method which excludes the possibility of retrieval is not in line with this policy and is therefore rejected.

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

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

Article 20. REGULATORY BODY

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework

referred to in Article 19, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.

a. General

As was discussed in the section on Article 19, a number of ministers are jointly responsible for the licensing, assessment and inspection of nuclear facilities. The various organisations within the ministries charged with these tasks, and the legal basis on which they operate, have already been discussed in the section on Article 19.2 :

- Directorate for Chemicals, Waste, Radiation Protection (SAS) of the Ministry of Housing, Spatial Planning and the Environment;
- Nuclear Safety Department (KFD) of the VROM Inspection of the Ministry of Housing, Spatial Planning and the Environment;
- Nuclear Security and Safeguards Section of the Nuclear Safety Department of the VROM Inspection, Ministry of Housing, Spatial Planning and the Environment.
- Regional Inspection (south-west region)(VI-ZW) of the VROM Inspection of the Ministry of Housing, Spatial Planning and the Environment;
- Directorate for Safety and Health at Work (Occupational Safety) of the Ministry of Social Affairs and Employment;
- Directorate for Energy and Electricity Production of the Ministry of Economic Affairs;

The Ministry of Housing, Spatial Planning and the Environment has the overall responsibility for legislation concerning the Nuclear Energy Act, for licensing and for ensuring that the current legislation is being adequately enforced. This ministry is also responsible for the technical safety considerations on which the decision to grant or reject an application for a licence is based. These considerations are mainly based on the assessments and inspections by the KFD. The VI-ZW, also operating under the Ministry of Housing, Spatial Planning and the Environment, assesses compliance with requirements relating to effluent discharge and environmental protection against non-radioactive pollutants as well as to radiation and environmental protection aspects in non-nuclear fuel cycle related institutions or industries.

The various bodies are described in more detail in the following sections.

b.1 Directorate for Chemicals, Waste, Radiation Protection (SAS)

The main task of this Directorate is policy development and implementation in the field of radiation protection in relation to the public and the environment. The Directorate is also responsible for licensing nuclear installations and nuclear transports in general (all procedural aspects), as well as for all aspects concerning radiation protection and external safety. It has expertise in the following disciplines at its disposal: radiation protection, risk assessment, radioactive waste management including disposal and legal and licensing matters. These disciplines are grouped together in the Radiation Protection, Nuclear and Biosafety Division. The above-mentioned duties do not require any specific budget, apart from that needed to cover staff costs. SAS does, however, make an annual contribution jointly with the VI to support the work of the RIVM (National Institute for

Public Health and the Environment). Within SAS, about seven man-years per year are devoted to nuclear licensing and safety issues. SAS is also in charge of facilitating research in the areas mentioned above. Recently SAS has initiated a new national research programme to further explore the technological and societal aspects of retrievable disposal of radioactive waste in suitable geological formations in the deep underground.

b.2 Nuclear Safety Department (KFD)

The largest organisation within the regulatory body is the KFD, which encompasses all major (reactor) safety disciplines. Still the organisation is rather limited given the small nuclear program in The Netherlands. For areas in which its competence is not sufficient or where a specific in-depth analysis is needed, the KFD has a budget at its disposal for contracting outside specialists. This is based on one of the KFDs basic policies: the core disciplines should be available in-house, while the remaining work is subcontracted to third parties or technical safety organisations.

The core disciplines are:

- mechanical engineering;
- metallurgy;
- reactor technology (including reactor physics and thermal hydraulics);
- electrical engineering;
- instrumentation and control;
- radiation protection;
- probabilistic safety assessment and severe accidents;
- quality assurance;
- nuclear safety auditing and inspecting;
- process technology.

Basically, there is one member of staff for each discipline (although there are two for process technology). Three people are available full-time for conducting routine inspections of the installations.

The total professional staff of the KFD, including management, is 17 at present including one vacancy. Three of them are field inspectors. Each member of staff has at least ten years' experience in his or her respective discipline. The Department has a policy of allocating between 10 and 15 days each year to training.

Its main activities contribute to regulation (licensing and rulemaking), assessment and inspection. In principle, staff can be deployed on any task. The work is co-ordinated by three project managers, using a matrix organisation.

As regards budgets for external support, there is a budget equivalent to three man-years for contracting specialists on a temporary basis. On top of this, there is an outsourcing budget of about € 500.000 for contracting out special issues to outside experts or technical safety organisations in The Netherlands and abroad.

b.3 VROM Inspection (VI-ZW)

The VROM-Inspection/Regional Inspection S/W (VI-ZW) is responsible for supervising radiation protection in non-fuel cycle related enterprises with particular emphasis on environmental aspects as well as environmental impact of non-radioactive discharges in nuclear facilities.. This means that its principal concern is the interface between an activity involving radioactive material and the monitoring of the quality of the local environment. The VI-ZW has a capacity of approximately one man-year per year for exercising this supervision. The Inspectorate's budget includes an annual contribution to the RIVM, which it pays jointly with the SAS, as has already been mentioned.

b.4 The Directorate for Safety and Health at Work

This Directorate within the Ministry of Social Affairs is responsible for the legal aspects of radiation protection of workers. One man-year is allocated to this work.

b.5 The Directorate for Energy Production

The Directorate for Energy and Electricity Production (Ministry of Economic Affairs) is responsible for policy matters concerning the energy supply. Within this Directorate about two man-year are devoted to Nuclear Energy Act matters.

b.6 Nuclear Security and Safeguards Section

The security of nuclear power plants (in terms of nuclear security and safeguards) forms a separate element of the spectrum of supervisory duties. This supervisory function has recently been added to the VROM Inspection of the Ministry of Housing, Physical Planning and the Environment. Two man-years per year are allocated to this work.

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

On 21 June 1999, a decree was published in which the care for the maintenance and implementation of the Nuclear Energy Act and for the regulations based upon this act was transferred from the Minister of Economic Affairs to the Minister of Housing, Spatial Planning and the Environment. This means *inter alia* that the prime responsibility for the licensing of nuclear installations lies with the minister who is also responsible for the protection of the public and the environment. The influence of the Minister of Economic Affairs is restricted to aspects concerning the energy supply; he no longer has control over any other aspects, including protection. Through this arrangement the conditions as described in Article 20.2 of this Convention concerning effective separation are fully satisfied.

Article 21. RESPONSIBILITY OF THE LICENCE HOLDER

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

The principle that the ultimate responsibility for safety lies with the licensee is laid down in several layers of regulation. The highest level is the Nuclear Energy Act where in the explanatory memorandum of Article 37b it is stated that the licensee must operate a nuclear facility in a manner that reflects the most recent safety insights.

In the next layer, the Radiation Protection Decree, Articles 9–11 and the Nuclear Installations, Fissionable materials and Ores Decree , Article 19, the operating organisation is held responsible for providing adequate human and financial resources in order to ensure that the facility can be operated in a safe way. More specifically these articles specify that the licensee should meet with the following conditions:

- The licensee should take steps to ensure that all practices involving radioactive material should be conducted by or under supervision of a qualified expert.
- The licensee is required to provide financial resources which are adequate to protect persons against the harmful effects of ionising radiation.
- The licensee is required to ensure that plans for work activities involving radioactive material are thoroughly reviewed, risks are adequately analysed and final approval is accorded by or under responsibility of the qualified expert prior to commencement of the work.
- The licensee is required to ensure that radiation protection equipment is maintained in a good condition and that deficient equipment or parts thereof are repaired or replaced.

Although the structure is slightly different, Art. 9 of the Nuclear Installations, Fissionable materials and Ores Decree, which is in the same layer as the Radiation Protection Decree, stipulates that in the documents to be submitted when applying for a license, the applicant should demonstrate that persons are adequately protected against the effects of these materials.
In a new Art. 10 of this decree, an application for a decommissioning license should include a description of the proposed decommissioning strategy, a decommissioning plan and a demonstration of adequate financial resources for the implementation of this decommissioning plan.

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

In Articles 22 and 33 of the Nuclear Energy Act provisions has been made for situations where the owner or other responsible person or organisation of fissionable material (including spent fuel) or radioactive material respectively cannot be identified. This applies for example to orphan sources. In such cases the Nuclear Safety Inspectorate and the Health Inspectorate have been empowered to impound such material and have it transferred it to designated institutes, which are equipped and licensed to manage these materials.
These institutes which have been designated by a special decree [8] are the following:

The Energy Research Foundation in Petten and the Central Organisation for Radioactive Waste (COVRA) in Borsele for fissionable materials and the same institutes as well as the State Institute for Health and the Environment in Bilthoven for radioactive materials.

Article 22. HUMAN AND FINANCIAL RESOURCES

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

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

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

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

See the text under Art. 21 of this Convention

Article 23. QUALITY ASSURANCE

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

General

Due to the limited size of the nuclear industry, it was not cost-effective to develop a specific national programme of QA rules and guidelines. As a result, the IAEA SS QA Series No. 50-C-Q was chosen to provide the basis for the QA programme in the Netherlands. Although the IAEA-NUSS QA Safety Series are primarily set up for nuclear power plants, some of these are applied to the COVRA facilities for the storage of spent fuel and radioactive waste. In particular, the adapted version of the IAEA Code for the safety of Nuclear Power Plants [9] is used as source material for the QA programme of COVRA. Since this Code is specific for NPP's, provisions from the industrial standards NEN-ISO 9000 – 9004 have also been implemented

Regulations

The QA system of COVRA is part of the operating license and hence is binding for the licensee. Those parts of the QA programme that apply specifically to design and construction of the installations and to the safe operation of the spent fuel and waste management facilities require prior approval from the Nuclear Safety Department of the Regulatory Body.

Specific points in the QA system

The core of the QA system is the Quality Manual. This Manual describes procedures for the following issues:

- Acceptance criteria for radioactive waste and storage procedures;
- Document controls
- Emergency response measures;

- Procedures for security;
- Procurement control;
- Design control for new and modified installations;
- Management of inspections and tests.

Quality assurance within the regulatory body

In 1997 the KFD started with a formal process to introduce a quality system for all its tasks. Traceability, predictability and optimisation of the regulatory activities were the leading principles in this QA-process. In 1999 the KFD obtained its first ISO-9001 certificate. The ISO certification was chosen *inter alia* because this standard is well known in industrial and governmental circles.

By application of the Quality System the following benefits were obtained:

- A transparent organisation structure and procedures in which the decision making process became visible
- An improved awareness of the required quality of the processes in which the KFD is involved
- The formulation of objectives and projects with feedback of the results accomplished
- A better separation of policy and assessment/ inspection in the performance of tasks
- A structured approach accommodating improvements where necessary

The KFD Quality System is based on NEN-EN-ISO 9001 and NVR 1.3 (Code for Quality Assurance for the Nuclear Power Plants, adapted from IAEA Code Safety Series 50-C-Q (Rev.1) with accompanying safety guides.

Article 24. OPERATIONAL RADIATION PROTECTION

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

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

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

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

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse); and

- the Radiation Protection Decree (Bs).

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

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

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

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

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

Protection of the workers

The licensee of the COVRA storage facility has taken measures to ensure that radiation doses for the most exposed workers remain well under the dose limit. The design of the installations and the work procedures are aimed to maintain a dose constraint of 6 mSv for the individual dose. In 2002 the highest individual dose recorded for the 43 radiation workers was 0.8 mSv. The collective dose for these persons was about 18 millimanSv in the same year. In the last decade the occupational exposures have shown little variance from the values mentioned.

In order to comply with the set targets, the outside area, the buildings and the working spaces are divided in four colour-marked zones according to the scheme below:

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

The white zone comprises the non-controlled area. For purposes of radiation protection there are no access restrictions. Under normal circumstances there is no contamination with radioactivity in this zone. If it occurs anyway it is due to an incident and consequently temporary in nature. In this case access restrictions apply until the contamination has been removed and the area has been cleared by the Radiation Protection Department. Radiation levels can be enhanced temporarily in the neighbourhood of vehicles carrying radioactive cargo.

The green, orange and red zones constitute the controlled zone. These zones are situated exclusively within buildings and are not accessible without permission of the Radiation Protection Department. In the green zone the length of stay for radiation workers is unlimited. The working procedures for the other zones are laid down in written instructions.

Part of the reactor pool at HFR is used for the temporary storage of spent fuel, pending transport to the USA or to COVRA. In another section of the pool the operating reactor vessel is located. This means the measures to protect the workers are mainly determined by the day-to-day operations around the reactor pool. This work consists mainly of loading and unloading of experiments and isotope production facilities. The following measures are taken to ensure that workers are properly protected:

- From the viewpoint of radiological protection the reactor hall is declared an controlled area. This means that access is limited to those individuals who have the right to be enter, with appropriate protective clothing and an dosimeter.
- Around the spent fuel and reactor pool (3rd level) new protective clothing, shoes and gloves are mandatory.
- The dose rate arising from radioactive material in the pool water is the main source of radiation to workers. This dose rate is kept as low as reasonably achievable by filters through which the pool water is circulated. Regularly the water is replenished with clean water, since a few cubic meters of water as lost weekly by evaporation.
- The number of workers present around the pool is kept as low as practicable, which is partly achieved by appointing one of the operators as radiation protection officer.

The result of these measures is a yearly effective dose to workers not exceeding 6 mSv. The collective dose for the 70 workers in HFR operations is presented is the following table.

Year	1997	1998	1999	2000	2001	2002
Collective dose (man.mSv)	98.7	83.7	111.3	108.0	112.0	95.9

These doses include the dose incurred during handling operations with spent fuel. Each reactor cycle of 27 days is followed by a short maintenance period during which the reactor vessel is completely unloaded. Most fuel elements are put back in the reactor, but a few elements are stored as waste. In contrast to the situation at NPP's, the dose during these fuel operations is lower that during the normal work.

Similar criteria apply to the HOR research reactor in Delft

Protection of the public

Storage of radioactive waste in the buildings is carried out in such a way that the equivalent dose rate at the border of the establishment is as low as reasonably achievable (ALARA), but not higher than a fraction of the dose limit for the public (1 mSv). In COVRA's operating license this fraction is set at 0.16 mSv/y ambient dose. This assumes conservatively that somebody could be present at the fence of the establishment for an indefinite period of time without being exposed to any significant risk.

Both the licensee (COVRA) and an independent institute (State Institute for Public Health and the Environment, RIVM) monitor the radiation levels at the border of the establishment continuously. In 2002 the average increase of the background radiation level due to the activities at COVRA amounted to 0.012 mSv. This is much lower than the limit accorded to COVRA in the operating license.

At the HFR research reactor in Petten the radiological protection of the public other than arising from discharges (see the next section) is achieved by controlling the cumulative radiation dose at the site boundary. The main source of radiation is the radioactive content of the heat exchanger building that is located outside the reactor building. At specific location at the site boundary thermoluminescent detectors are installed that are read out every quarter year. The results of these measurements are corrected for background radiation (measured elsewhere on the site) and multiplied by the fixed factor related to the maximum period of time any person might conceivably be present at the site boundary. The resulting dose has always been lower than 0,002 mSv in any year since the beginning of these measurements in 1984. Usually the limit for this annual dose is set at 0,04 mSv.

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

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

- Category 1. Normal operation
- Category 2. Incidents
  This category describes events, having an irregular frequency of occurrence (about once a year) such as failure of the electrical supply for a short period;
- Category 3. Accidents
  In this category all accidents are included which could occur during the operational life of the facility, such as a fire in the installations, a drop of a package with radioactive contents, or failure of the electrical supply during substantial periods. The frequency of occurrence is in the order of magnitude of 1 × per 10 – 100 year.
- Category 4. Extreme accidents
  These are accidents which, without mitigating measures, could have an impact on the environment. Some of these events have been taken into consideration in the design of the buildings and of the installations. The frequency of occurrence is in the order of magnitude of 1 × per 100 – 1,000,000 year.

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

- Flooding of the buildings
- Earthquakes
- Hurricanes
- Gas cloud explosions
- Release of toxic and/or corrosive substances

- Crashing aircraft (military aircraft)
- External fire

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

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

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

The measures taken to prevent unplanned and uncontrolled releases from HFR are similar to any other working nuclear installation. The main feature in this respect is the containment building. This structure will prevent any uncontrolled discharge of radioactive material into the environment during normal operations and design base accidents.

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

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

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

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

Both atmospheric and liquid discharges of radionuclides are restricted by requirements in the operating license of COVRA. In the table below the annual discharge limits for different categories of radionuclides are represented.

	Annual discharges		
Category	**Airborne**	**Liquid**	**Total**
Alpha	1 MBq	80 MBq	81 MBq
Beta/gamma	50 GBq	200 GBq	250 GBq
Tritium/C-14	1 TBq	2 TBq	3 TBq

The actual emissions of radionuclides is only a small fraction of the limits specified in the license, as demonstrated in the following diagram:

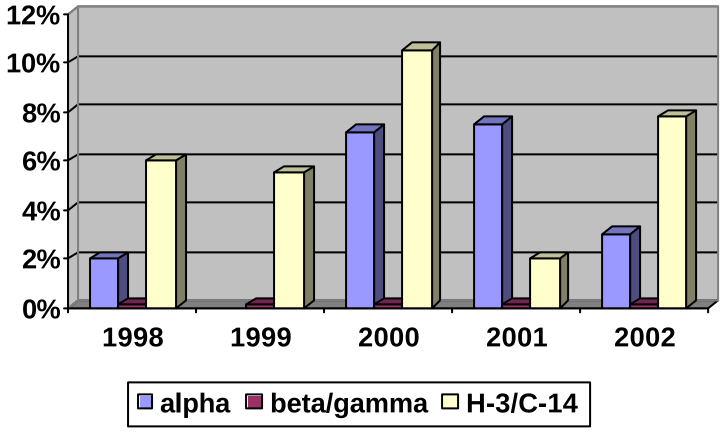


Figure 3. Emissions of radionuclides to the environment as a percentage of the annual limit

Discharges from the HFR.

Argon-41 is the dominant component of the regular discharges of HFR. Also tritium is present in the emissions and rarely small traces of I-131 are detected in the HFR stack. The limit is set at a discharge of 66.6 TBq for the sum of these nuclides. The actual discharges are presented in the following table:

Year	1999	2000	2001	2002
Discharge (TBq)	14.8	9.9	8.0	5.8

These discharges are mainly determined by Ar-41 with a half life of 110 minutes. This radionuclide is formed only during the active operation of the reactor, and therefore is not the result of the storage of spent fuel.

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

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

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

Article 25. EMERGENCY PREPAREDNESS

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

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

Although there are no legal requirements with respect to on-site emergency response measures, the operation license of COVRA stipulates that a plan should be established and maintained.

On-site emergency provisions

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

The emergency plan has three principal goals:

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

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

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

Off-site emergency provisions

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. A distinction is made between facilities where accidents could potentially have an impact on the whole country (category A objects) and facilities where this is less likely and consequences are assumed to be restricted to the immediate surroundings of the facility (category B-objects). Facilities classified in category A typically include nuclear power stations. The COVRA storage facility is classified as a type B-object. However, in practice the national government will be involved in the emergency response because of the exclusive availability of nuclear expertise. Chapter VI of the Nuclear Energy Act also sets out the competences and the dependencies of the authorities that are responsible, *inter alia*, for the preparation and the organisation of measures in response to emergencies. Under Article 40 of the Act the central government carries the bulk of the responsibility, both for the preparatory work and for actually dealing with any emergency that may arise in practice. The operational structure of the system for dealing with nuclear accidents is set out in the National Nuclear Emergency Plan (NPK). The NPK-organisation consists of the following groups:

- A national alarm and coordination centre where all reports of nuclear incidents and accidents as well as other environmental incidents are reported. This centre is staffed and accessible 24 hours a day.
- An alert assessment team (BOT). This team assesses whether an incident or threat has to be scaled up or not and whether the full NPK organisation has to be notified and called on duty if necessary.
- A Technical Information Group (TIG). This group advises the policy team in case there is a real threat of an off-site emergency in a nuclear installation or a radioactive release (national or in a neighbouring country). It is an expansion of the BOT after an incident has been scaled up. For efficient operation of the TIG the following functional sub-groups are part of this group:

  Source (Accident sequence inside installation; KFD expertise)

  Meteo

  Dispersion and measurement strategy

  Direct measures

  Indirect measures

  Use is being made of several support organisations like KFD think-tank or Royal Dutch Meteorological Institute or the National Institute for Public Health and the Environment. The latter institute operates the national grid of radiation monitors and coordinates the 'local' measurements in the early phase of the accident. Also this institute performs the dispersion calculations of the release.
- A policy team. This team makes decisions regarding the measures to be taken. It consists of ministers and senior civil servants. The team is chaired by either the minister of Housing, Spatial Planning and the Environment or the minister of the Interior (Home Affairs).
- National information centre. This centre is responsible for the co-ordination of information to be provided to the public, the press, other national and international authorities and specific target groups such as farmers.

Two large scale accidents in the Netherlands, namely a blazing fire in a pub and an explosion in a fireworks plant, both causing around 20 casualties, as well as the attack on the WTC in New York City prompted the start of a national project aimed to streamline the emergency planning and response to such accidents. Intervention in case of nuclear accidents and accidents involving radioactive sources was also subjected to a review. Currently a revitalisation process is taking place of the NPK organisation in order to achieve better harmonisation with the regular emergency planning and response organisations. Main purpose of the project is to reduce the differences between nuclear emergency preparedness and the planning and response for other "regular" types of disasters and crises. Another main objective is to improve the organisation and the means to inform the public and the media in case of a nuclear emergency. This project is now in its implementation phase and expected to be completed in 2004.

The likely outcome of this project is a package of measures aimed to improve both the preparedness to accidents and the effectiveness of the response. These measures will particularly apply to the most vulnerable steps in the nuclear fuel cycle. The effects on waste management facilities or on waste management departments of other nuclear facilities is likely to be limited.

For example, the safety assessments of the different treatment and storage buildings for radioactive waste at COVRA have demonstrated that even the most severe accident considered would not give rise to unacceptable risks outside the border of the facility. Furthermore the waste management departments of the NPP Borssele and the research reactors are not the most vulnerable part of these facilities. However for purposes of emergency planning, the following generic intervention levels and measures are observed:

Preventive evacuation:	1000 mSv H_{eff} or 5000 mSv H_{th}
First day evacuation:	500-50 mSv H_{eff} or 1500 mSv H_{th}
Late evacuation:	250-50 mSv (first year dose)
Relocation/return:	250-50 mSv (first 50 years after return)
Iodine prophylaxis:	child 500 mSv; adult 1000 mSv (first day)
Sheltering:	50-5 mSv H_{eff} or 500-50 mSv H_{th} (first day dose)
Grazing prohibition:	5000 Bq I-131 per m^2
Milk(products), drinking water etc:	500 Bq/l I, 1000 Bq/l Cs, 125 Bq/l Sr, 20 Bq/l alpha emitters.

There are also derived intervention levels for foodstuffs that follow the appropriate EU regulations.

Article 26. DECOMMISSIONING

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

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

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

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

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

Introduction

In the Netherlands the following nuclear facilities are in operation or have been shut down recently:

Name of facility	Type	Power	Status	Date of closure
Borssele	NPP	475 MW_e	Operational	N.a.
Dodewaard	NPP	59 MW_e	Shut down	1997
High Flux Reactor (HFR), Petten	Research reactor	45 MW_{th}	Operational	N.a.
Low Flux Reactor (LFR), Petten	Research reactor	30 kW_{th}	Operational	N.a.
Hoger Onderwijs Reactor (HOR)	Research reactor	2 MW_{th}	Operational	N.a.
Urenco	Uranium enrichment	N.a.	Operational	N.a.
COVRA	Waste treatment and storage facility	N.a.	Operational	N.a.

The Dodewaard NPP is the only nuclear facility which is currently in a state of decommissioning. It was shut down in 1997 after 28 years of operation.

National policy

International consensus exists that there are basically three different strategies for the decommissioning of nuclear power stations:

i) direct dismantling within a period of ten years;

ii) delayed dismantling within 50 years, after bringing the facility in a safe enclosure (SE);

iii) "in situ" dismantling after a period of SE;

In the EIA for the Dodewaard NPP these three strategies were considered. In principle, the operator of the NPP designates one of these strategies as the preferred alternative on the basis of a decommissioning plan. Since the environmental impact was minute for all strategies considered the operator decided in favour of the least expensive strategy, namely postponed dismantling, with a waiting period of 40 years. Although the government had a slight preference for immediate dismantling for various reasons, no objection was raised against the decision of the operator.

After dismantling of all the structures of the NPP the end-point is:

- Removal of all potentially contaminated structures and installations;
- Proper management of radioactive waste;
- Removal of residual radioactive contamination from the site according to agreed clearance levels. The target is clearance for unrestricted use.

This corresponds with what is generally described as the "green field" situation.

In May 2002 a license for was granted to GKN, the operator of the NPP Dodewaard, to bring and keep the plant in a safe enclosure.

It is expected that for the same reasons postponed decommissioning will be the preferred option for the nuclear power station in Borssele. The date for its closure has not yet been established and, consequently, no firm decisions have been made.

There are no plans yet for the decommissioning of the other nuclear facilities. COVRA will remain in operation for at least 100 years.

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

It is envisaged that COVRA, which is a 100 % state owned company will become responsible for the shut down Dodewaard NPP. This decision in principle was taken to improve the efficiency of radioactive waste management in connection to the decommissioning steps following the removal of all spent fuel from the NPP. The obligations regarding operational radiation protection and emergency preparedness can also be properly met when the decommissioning activities of the Dodewaard NPP are managed by COVRA.

Financial aspects
Although a strict legal requirement to ensure that adequate funding is available for decommissioning does not exist, there is a general understanding that the "polluter pays principle" applies. This has resulted in the incorporation of a specific condition to that effect in the operation license of both NPP's. Consequently, the operators of NPP's were required to make financial provisions for decommissioning.

In the case of the Dodewaard NPP the cost of decommissioning was calculated with the programme STILLKO 2, a cost evaluation model, developed by NIS Ingenieurgesellschaft mbH. The STILLKO 2 programme has been used for the calculation of the decommissioning cost of other NPP's in Belgium and Germany. The programme has a structure which comprises the following basic elements:

- a structural plan
- a mass analysis
- an evaluation of working steps
- a time schedule

By utilising the STILLKO 2 model the total non-discounted decommissioning costs including the preparation for safe enclosure and a 40 years waiting period for the Dodewaard NPP were estimated at about M€ 160.-.

Record keeping
In the preparatory phase to the safe enclosure the licensee of the NPP Dodewaard completed the establishment of the Dodewaard Inventory System (DIS). The objective of the DIS is to describe in detail all relevant radiological data in the controlled zone of the NPP in a database. This database is designed both for present decommissioning activities leading to the safe enclosure, as well as for future dismantling operations. Since the dismantling activities will take place after at least 40 years, much attention will be given to keep the information in a form that ensures its accessibility by the systems in use at that time.

CHAPTER 5. MISCELLANEOUS PROVISIONS

Article 27. TRANSBOUNDARY MOVEMENT

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

In so doing:

- **i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;**
- **ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;**
- **iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;**
- **iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;**
- **v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.**

The Netherlands as a member state of the European Union has implemented in its national legislation Council Directive nr. 92/3/Euratom[10]. This directive sets out the same requirements as the ones specified in paragraphs (i) – (v) of this article of the Joint Convention.

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

This paragraph derives from the Antarctic treaty to which the Netherlands is a Contracting Party.

3. Nothing in this Convention prejudices or affects:

- **i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;**
- **ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;**
- **iii) the right of a Contracting Party to export its spent fuel for reprocessing;**
- **iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.**

The Netherlands has implemented the international agreements on the transport of radioactive materials for the different modes of transport as released by ICAO (air transport), IMO (sea transport), ADR (road transport) and RID (rail transport) and ADNR (transport over inland waterways). The provisions in these agreements are not affected by the Joint Convention.[11,12,13,14,15]

Article 28. DISUSED SEALED SOURCES

1. **Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.**
2. **A Contracting Party shall allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.**

As a general rule sealed sources, which are no not longer in use either by having decayed to impractical levels or by discontinuation of the practice, are considered radioactive waste. Users of such sources are required by pertinent provisions in their operating licenses to have their stocks of radioactive waste removed by the recognised agency (COVRA) at regular intervals. This ensures that no disused sources are present for longer periods at a user's site.

Alternatively, particularly in cases where sources have to be replaced regularly due to relatively short half-lives, spent sources are taken back by the manufacturer for disposal or reactivation.

Article 32. REPORTING

1. **In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:**

   (i) spent fuel management policy;
   (ii) spent fuel management practices;
   (iii) radioactive waste management policy;
   (iv) radioactive waste management practices;
   (v) criteria used to define and categorize radioactive waste.

2. **This report shall also include:**

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

The policy of the Netherlands with respect to spent fuel management and radioactive waste management has been addressed in a generic manner in the text under Articles 4

and 9 of this report. Further details, including the underlying reasons for this policy, are presented in Appendix 1.
The inventories of radioactive waste as submitted by COVRA to the IAEA Net-Enabled Waste Management Database (NEWMD) and updated for the situation in December 2002, are given in Appendix 2.
Inventories of spent fuel at the COVRA facility as well as those of the research reactors HFR in Petten and HOR in Delft are given in Appendices 3, 4 and 5 respectively.

Appendix 1. STORAGE OF RADIOACTIVE WASTE IN THE NETHERLANDS

1. Storage facilities

All radioactive waste produced in The Netherlands is managed by COVRA, the Central Organisation for Radioactive Waste. COVRA operates a facility at the industrial area Vlissingen-Oost in the south-west of the country.
COVRA has a site available of about 25 ha at the industrial area where the conditioning and the long-term storage (at least 100 years) takes place. The facilities for low- and medium-level waste were erected between 1990 and 1992. In 2000 a storage building for the storage of very low level radioactive waste from ore processing industries was commissioned (TENORM waste). The construction of a naturally cooled storage facility for high level waste started in 1999 and will be commissioned in 2003. The construction of a storage facility for depleted uranium will start in 2003 and will be commissioned in 2004.
A lay out of the COVRA facilities as present today, is given in figure 1.

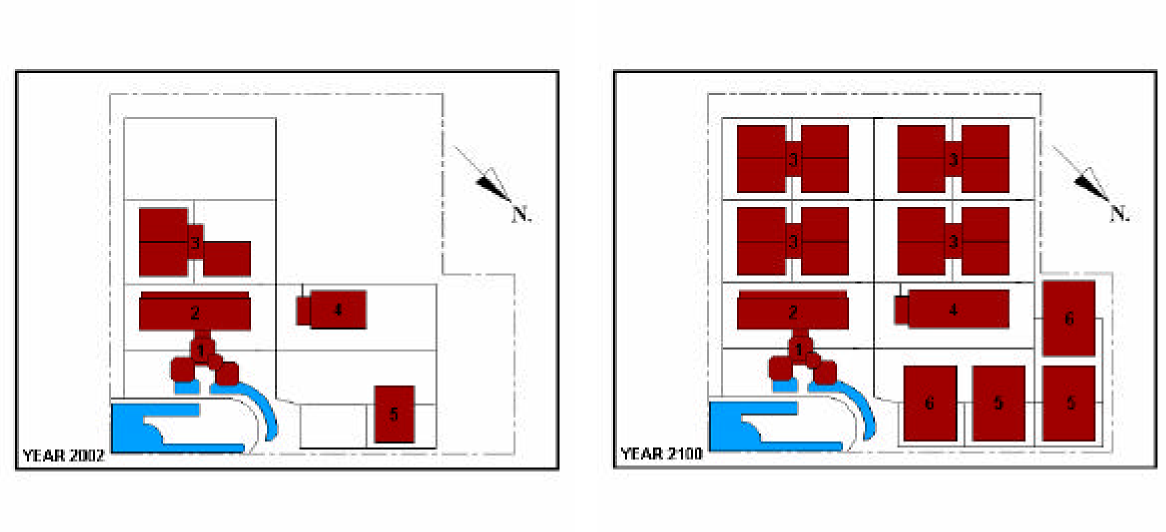


Figure 1. Lay-out of the COVRA facilities in 2003 and the situation after 2100

1 – office building and exhibition centre;
2 – building for the treatment of low and medium level waste;
3 – storage building for conditioned low and medium level waste;
4 – storage building for high level waste;
5 - storage building for low level waste from the ore processing industry;
6 - storage building for depleted uranium.

All storage facilities are modular buildings. The storage building for low and medium level waste is H-shaped (nr. 3 in the figure) and it consists of a central reception bay surrounded by four storage modules. Each storage module presents a storage capacity for ten years of waste production at the present rate. In figure 1 the situation is also presented for a completely filled site, which will be at a time after 2100. As can be seen from this figure, in total 16 storage modules for low and medium level waste can be constructed which represents some 160 years of waste production.

Of the storage building for TENORM waste (nr 5 in the figure), only one third of the full building is in operation right now. Three more buildings of approximately the same size can be constructed in the future as can be seen from the situation after 2100 in figure 1. One or possibly two of these buildings will be used for the storage of depleted uranium.
It is expected that the potential storage capacity here will be sufficient for fifty to hundred years.

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

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

1.1 Low and medium level waste

All waste is conditioned in cement in relatively small units. Cement is a very stable product and creates an alkaline environment for the waste materials. This will prevent or slow down the degradation of the waste materials. Producing relatively small units of 200 or 1000 litre makes it easy to handle the units for repair.
In the storage building blocks of waste packages are placed in rows, which leave open corridors for inspection. Lower dose rate packages are stored along the outer walls of the modules, and on the top layers in order to provide additional shielding for higher dose rate packages at the interior (see figure 2).
The storage building is a simple concrete building; there is no mechanical ventilation. With mobile equipment humidity in the building is kept at a low level in order to prevent condensation of air moisture on the packages. The storage area is a contamination free area.

Figure 2. Storage of low and medium level waste

1.2 *TENORM and depleted U*

The TENORM waste that has to be stored is a calcinate with only Po-, Bi- and Pb-210. It is a stable product that does not need to be conditioned to assure safe storage. Any additional conditioning would enlarge the volume and would add to the costs. The calcinate is collected in a specially designed 20-ft container. The container can be filled with up to 30 tonnes of material. The containers are stacked four high in the container storage building (see figure 3).

The container storage building is a steel construction frame with steel insulation panels. High quality criteria were set for the construction and for the type of materials used in order to meet the 150 years lifetime with practical maintenance. The building can modularly be expanded and per storage module an overhead crane is present. Technical provisions inside the building are minimal. With mobile equipment the air humidity in the storage building is kept below 60%. All containers must be free of outside contamination.

Figure 3. The storage of radioactive calcinate from phosphor production

In 2003 the construction of a storage building for depleted U_3O_8 will start. This will be a concrete building again with minimal fixed installations or equipment, comparable to the store for low and medium level waste.

The depleted U_3O_8 is a stable product to store. Because of its potential future use the material will not be conditioned in a fixed matrix. When judged necessary in the future, for instance when the material will be brought into a geologic disposal facility, then this can be done according to applicable standards at that time. Money for this treatment and for the final disposal will be set aside in a capital growth fund in the same way as is done for all other waste stored at COVRA.

1.3 *High level waste*

Because of the long term storage requirement a system was chosen that is as passive as possible and where precautions are taken to prevent degradation of the waste packages. The heat generating waste is stored in an inert noble gas atmosphere and cooled by natural convection. In the design of the storage vault all accidents with a frequency of occurrence larger than once per million years were taken into account. The design must be such that these accidents do not cause radiological damage to the environment.

The non-heat generating waste is, remotely controlled, stacked in well-shielded storage areas. The heat generating waste such as the vitrified residues will be put into vertical storage wells cooled by natural ventilation. This method is proven technology in the storage facilities of BNFL at Sellafield and of Cogéma at La Hague.

The spent fuel elements of the research reactors are delivered to COVRA in a cask containing a basket with circa 30 elements. The basket with elements is removed from the cask and placed in a steel canister, which is welded tight and filled with an inert gas. These sealed canisters are placed in wells, in the same way as the vitrified residues. The wells will be filled with an inert gas to prevent corrosion of canisters with spent fuel elements or vitrified waste (see figure 4).

The construction of the storage vault started in 1999 and it will be commissioned in 2003. (see figure 5)

Figure 4. Emplacement of the wells during construction

Figure 5. HABOG shortly before completion

2. Policy for long term storage followed by disposal

The policy in the Netherlands is that all hazardous waste must be isolated, controlled and monitored. In principle this can be done by storage in buildings and control by society. Also this can be done by shallow land burial and control of society, or by deep geologic disposal and control of society. For the options mentioned the degree of societal control is the highest for storage in buildings and the lowest for deep disposal. When containment is required over periods of time longer than the existence of society doubt may raise on the capacity of society to fulfil the control requirement.

The Netherlands has a very high ground water table and under those circumstances shallow land burial is not acceptable for the low and medium level waste. As a consequence for all waste categories deep geologic disposal will be required as ultimate solution.

Fortunately, deep lying, large salt formations with a good potential as disposal site, as well as deep clay formations, are available. Unfortunately however public acceptance for deep disposal is lacking. Some comfort can be given when the disposal is retrievable and this is a requirement for The Netherlands.

Also it should be realised that the waste volume that is actually present right now is only a few thousand m3 and for such a small volume it is not economically feasible to construct a deep geologic disposal facility. The waste volume collected in a period of 100 years can be judged as large enough to make a disposal facility viable. So a period of at least 100 years of storage in buildings will be required. This creates at least six positive effects:

1. Public acceptance is quite high for long term storage. The general public has more confidence in physical control by today's society than in long-term risk calculations for repositories even when the outcome of the latter is a negligible risk.
2. There is a period of 100 years available to allow the money in the capital growth fund to grow to the desired level. This brings the financial burden for today's waste to an acceptable level.
3. During the next 100 years an international or regional solution may become available. For most countries the total volume of radioactive waste is small. Co-operation creates financial benefits, could result in a higher safety standard and a more reliable control.
4. In the period of 100 years the heat generating waste will cool down to a situation where cooling is no longer required.
5. A substantial volume of the waste will decay to a non-radioactive level in 100 years.
6. A little bit more than 100 years ago, mankind was not even aware of the existence of radioactivity. In 100 years from now new techniques or management options can become available.

A dedicated solution for The Netherlands is therefore to store the waste in buildings for a period of at least 100 years and to prepare financially, technically and socially the deep disposal during this period in such a way that it can really be implemented after the storage period. Of course at that time society has the freedom of choice between a continuation of the storage for another 100 years or to realise the final disposal.

Appendix 2. DATA SUBMITTED TO THE IAEA NEWDB

International Atomic Energy Agency	NEWMDB Report
Groups Overview	
Country: Netherlands	**Reporting Year: 2002**

Reporting Group: **COVRA**

Inventory Reporting Date: December 2002

Waste Matrix Used: National

Description: COVRA,Centrale Organisatie Voor Radioactief Afval (Central Organisation For Radioactive Waste), the radioactive waste management organisation in the Netherlands

Facilities Defined				
Site Name	Processing	Storage	Disposal	Dedicated SRS
COVRA	1	1	0	0

Site Data: COVRA

Country: Netherlands **Reporting Year: 2002**

Full Name: National radioactive waste treatment and storage site of COVRA

Inventory Reporting Date: December 2002 Waste Matrix: National

Waste Inventory

Class	Location	Proc.	Volume (m3)	Distribution in %					
				RO	FF/FE	RP	NA	DF	DC/RE
LILW	Storage	Yes	7732	53	0	0	47	0	0
The additional characteristics of the waste: solid (non-dispersible)									
HLW, heat producing	Storage	Yes	0.8	0	0	0	100	0	0
The additional characteristics of the waste: hazardous (chemical); solid (non-dispersible)									

Proc.=Is the waste processed (Yes/No)?

RO=Reactor Operations, FF/FE=Fuel Fabrication/Fuel Enrichment, RP=Reprocessing, NA=Nuclear Applications; DF=Defence, DC/RE=Decommissioning/Remediation

Processing – Treatment method(s)

Method	Status			
	Planned	R&D program	Current practice method use over the last 5 years	Past Practice
Chemical Precipitation	No	No	same	No
Compaction	No	No	same	No
Incineration	No	No	same	No
Size Reduction	No	No	same	No
Super Compaction	No	No	same	No
Wastewater Treatment	No	No	same	No

Processing – Conditioning method(s)

Method	Status			
	Planned	R&D program	Current practice method use over the last 5 years	Past Practice
Cementation	No	No	same	No

Waste Class Matrix(ces) Used/Defined

Country: Netherlands **Reporting Year: 2002**

Waste Class Matrix: IAEA Def. , Not Used

Description: The Agency's standard matrix

Waste Class Matrix:	**National**		
Waste Class Name	**LILW_SL%**	**LILW_LL%**	**HLW%**
HLW, non heat producing	0	100	0
LILW	90	10	0
HLW, heat producing	0	0	100

Comment #NL/2000/250:

National waste categories

LILW, is called in Dutch the category of 'laag- en middel radioactief afval'. For the Dutch situation no distinction is made between short lived and long lived. The reason for this is that shallow land burial is not applicable for The Netherlands and therefore all categories of waste will be disposed of in a deep geologic repository in the future, that is after a period of long term storage. The long term storage will take place for a period of at least 100 years.

HLW, heat producing, is formed by the vitrified waste from reprocessing of spent fuel from the two nuclear power reactors in The Netherlands (Borssele and Dodewaard) and by the spent fuel of the two research reactors (Petten and Delft).

HLW, non-heat producing is mainly formed by the reprocessing waste other than the vitrified residues. It also includes a small amount of waste from research on reactor fuel and some decommissioning waste.

The waste class scheme for The Netherlands is not based on a law or a regulation. It is since long common practice to use this class scheme.

The percentages in the matrix are based upon a comparison of the definitions of waste classes in both The Netherlands' and the IAEA's waste classification schemes. The percentages cited are a best estimate.

MILESTONES

Country: Netherlands **Reporting Year: 2002**

Start Year or Reference Year: 1950 End Year	1982
Description of Milestone	
Sea dumping was used as disposal for LILW	

Start Year or Reference Year: 1982 End Year	1992
Description of Milestone	
Sea dumping was abandoned.	
COVRA was established as national waste management organisation. COVRA started as private company with limited liability and as shareholders the largest waste producers (90% of the shares) and the State of the Netherlands (10% of the shares) As an interim solution all LILW was conditioned and stored at the site of the Energy Research Foundation at Petten (Noord-Holland)	

Start Year or Reference Year: 1984 End Year	1992
Description of Milestone	
Between 1984 and 1987 a site selection procedure was followed to find a site where treatment and long term storage of all the nations radioactive waste would be established. In 1987 COVRA applied for a license (Nuclear Energy Act)for the present site at the Harbour and Industrial Area Vlissingen-Oost. The license was granted in 1989. Construction of waste treatment and storage facilities for LILW took place between 1989 and 1992. All LILW temporarily stored at the Petten site was transferred to the new site between 1992 and 1994.	

Start Year or Reference Year: 1994 End Year	2004
Description of Milestone	
In 1994 the preparations were started to obtain a license for the storage building for HLW and SF (HABOG building). After a long legal process, the granted license could be used in 1999. Construction of HABOG started and the facility will be ready to receive HLW from beginning of 2004.	

Start Year or Reference Year: 2004 End Year	2130
Description of Milestone	
Between 2004 and 2015 the HABOG building will receive HLW, this is the active phase of the facility. Between 2015 and 2130 HABOG will be in a passive storage phase. From 2130 all LILW, HLW and SF will be placed in a disposal facility, where the waste will be retrievable until the decision is taken for permanent closure.	

REGULATIONS

Country: Netherlands **Reporting Year: 2002**

Name	Kew			
Title or Name	Kernenergiewet (Nuclear Energy Act)			
Reference Number	Staatsblad 82, 1963, last revised 2002			
Date Promulgated	1963-02-21		Law	
or Proclaimed				
Wastes that are	Matrix National – LILW, HLW, non heat producing, HLW, heat producing			
covered by the identified				
Law				

Name	WMO-decree			
Title or Name	Beschikking inzake erkenning Centrale Organisatie voor Radioactief Afval			
	N.V. als ophaaldienst (Decree on establishment of COVRA as recognised			
	waste management organisation)			
Reference Number	Staatsblad 176, 1987			
Date Promulgated	1987-08-31		Law	
or Proclaimed				
Wastes that are	Matrix National - LILW, HLW, non heat producing, HLW, heat producing			
covered by the identified				
Law				

REGULATORS

Page 1 of 1 Country: Netherlands

Reporting Year: 2002

Name	**VROM**
Full Name	Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (Ministry of Housing, Spatial Planning and Environment)
Division	Stoffen, Veiligheid, Straling (SAS)
City or Town	Den Haag (The Hague)
Wastes that are regulated by the Regulator	Matrix National – LILW, HLW, non heat producing, HLW, heat producing

Name	**VROM**
Full Name	Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (Ministry of Housing, Spatial Planning and Environment)
Division	Nuclear Safety Department (KFD)
City or Town	Den Haag (The Hague)
Wastes that are regulated by the Regulator	Matrix National – LILW, HLW, non heat producing, HLW, heat producing

Name	**SZW**
Full Name	Ministerie van Sociale Zaken en Werkgelegenheid (Ministry of Social Affairs and Employment)
Division	Safety and Health at Work
City or Town	Den Haag (The Hague)
Wastes that are regulated by the Regulator	Matrix National – LILW, HLW, non heat producing, HLW, heat producing

Name	**EZ**
Full Name	Ministerie van Economische zaken (Ministry of Economic Affairs)
Division	Energy Production
City or Town	Den Haag (The Hague)
Wastes that are regulated by the Regulator	Matrix National – LILW, HLW, non heat producing, HLW, heat producing

Site Structure: COVRA

Country: Netherlands **Reporting Year: 2002**

Full Name:	National radioactive waste treatment and storage site of COVRA
License Holder(s) :	COVRA N.V. Spanjeweg 1 P.O.Box 202 4380 AE Vlissingen The Netherlands

Processing Facilities

Name	COVRA-AVG				
Description	AVG, AfvalVerwerkingsGebouw (Waste Treatment Building)is the building at the COVRA site where all low and intermediate level waste is treated and conditioned.				
Type	treatment, conditioning				

Storage Facilities

Name	COVRA				
Description	Various storage buildings are present at the COVRA site for LILW (LOG), HLW (HABOG), TENORM (COG)and for depleted U (VOG)				
Types of Storage Units					
Unit Name	Type	Operating Life (years)	Status	% filled	Modular
LOG	building	10	open	75	YES
COG	building	0	open	0	YES
VOG	building	0	open	0	YES
HABOG	bunker	0	open	0	YES

Appendix 3. INVENTORY OF SPENT FUEL AT COVRA

At COVRA's facility four Castor MTR2 storage and transport casks are stored in the building for LILW. Each cask contains 33 spent fuel elements from the research reactor in Petten. The activity in these casks amounts to 2448 TBq in total.

Appendix 4. INVENTORY OF SPENT FUEL AT THE HFR

Status as of 28 Feb. 2003

The total quantity is about 420 kg (or less than half a ton). This number will vary over the year for reasons explained in the note below (< 10%).

Approximate masses/element: 500 g (fuel element), 330 g (control rods element)

	Number	**U mass (g)**
Irradiated fuel elements:	817	408500
Irradiated control rod elements:	37	12210
Total irradiated:	854	420710

Note: updates are made at the end of every month. The inventory of irradiated fuel increases almost every month as per cycle (with 11 cycles/year) 6 new elements (5 fuel, 1 control rod) are put into use. The number will decrease later this year following transport of spent fuel.

Appendix 5. INVENTORY OF SPENT FUEL AT THE HOR

Status as of 10 Sept 2002

The total quantity is about 15 kg

Approximate masses/element: 200 g (fuel element), 100 g (control rods element)

	Number	**U mass (g)**
Irradiated fuel elements (HEU):	61	11143
Irradiated fuel elements (LEU)	1	1510
Irradiated control rod elements:	18	1903
Total irradiated:	80	14556

References

1. International Atomic Energy Agency, The Principles of Radioactive Waste Management, Safety Series 111-F, Vienna, 1995;
2. Environmental Impact Assessment Decree, Bulletin of Acts and Decrees 1999, 224;
3. Lower House, 1992-1993, 23163, no. 1;
4. Retrievable disposal of radioactive waste in the Netherlands, Final report of CORA study, Ministry of Economic Affairs, 2001 (http://www.minez.nl/publicaties/pdfs/div01.pdf);
5. Radiation Protection Decree, Bulletin of Acts and Decrees 2001, 397;
6. Decree on the designation of COVRA as recognised service for collection of radioactive waste, Bulletin of Acts and Decrees 1987, 176;
7. Decree to modify the Nuclear Installations, Fissionable materials and Ores Decree, Bulletin of Acts and Decrees 2002, 407;

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

9 NVR 1.3 Code for Quality Assurance for the Safety of Nuclear Power Plants, Adaptation of IAEA Code Safety Series 50-C-QA (Rev. 1)

10 Directive Nr. 92/3/Euratom of the Council of the European Communities of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community.

11 International Civil Aviation Organization (ICAO), Technical Instructions

12 International Maritime Organisation (IMO), International Maritime Dangerous Goods Code

13 Accord Européen relatif au Transport de Marchandises Dangereuses (RID)

14 Règlement International concernant le Transport des Marchandises Dangereuses par Chemins de Fer

15 Règlement pour le Transport des Matières Dangereuses sur le Rhin (ADNR)