Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

Seventh National Report of Austria

On the implementation of the obligations of the **Joint Convention on the Safety on Spent fuel and on the Safety of Radioactive Waste Management**

Vienna, October 2020

Legal notice

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Austria – Overview – Matrix

Type of Liabilty	Long-term management policy	Funding of Liabilities	Current Practice/Facilities	Planned Facilities
Spent Fuel	Return from research reactor (TRIGA – Vienna) to USA	State liability	Interim dry or wet storage on site	N/A
Nuclear Fuel cycle wastes	N/A	N/A	N/A	N/A
Application Wastes	Own disposal facility for LILW; Bilateral/Multilateral approach for small amounts of LILW – Long lived	Segregated fund for waste management – fully funded	Centralised conditioning and interim storage at NES	Modernisation of existing storage and conditioning facilities
Decommissioning Liabilities	Shutdown of TRIGA planned for 2025 and beyond	Liabilities covered by state	Decommissioning of research facilities and laboratories	Sufficient capacity at NES
Disused Sealed Sources	Return to supplier or transfer to NES	“Polluter pays”	Registration, collection and storage (at NES) or return to supplier	Sufficient capacity at NES

Executive Summary

There is neither a nuclear power plant (NPP) nor any other fuel cycle facility in operation in Austria. One NPP was constructed in Zwentendorf in the 1970s, but, as a consequence of the negative vote in a referendum, never put into operation. One TRIGA research reactor in Vienna is currently in operation. Spent nuclear fuel is stored on site in dry or wet storage facilities if necessary. Ultimately all spent fuel from the research reactor has been and will be returned to the USA.

Austria operates one central radioactive waste management and interim storage facility – Nuclear Engineering Seibersdorf GmbH (NES) - for predisposal management including treatment, conditioning and interim storage of all low- and intermediate level radioactive waste (LILW) originating from Austria. High-level radioactive waste (HLW) does not arise. LILW originates primarily from applications of radioactivity in medicine, research, industry and ongoing decommissioning projects. There is no disposal facility for radioactive waste in operation in Austria.

New:

Austria finalised the full transposition of the European Basic Safety Standards (Council Directive 2013/59/EURATOM) into national legislation. The implementing measures involved a wideranging revision of the whole Austrian Radiation Protection law including the adoption of the new Radiation Protection Act 2020 and of a set of Ordinances replacing the existing legal acts.

In September 2018 the Austrian Federal Government approved a National Program for Radioactive Waste Management and will establish a National Radioactive Waste Management Committee.

Austria conducted its first IRRS mission in 2018 and is currently finalising the action plans implementing the findings of the mission.

The modernisation of the central radioactive waste management and interim storage facility is ongoing. Some related projects have already been completed or are near completion.

A Introduction

The seventh Austrian National Report contains updated information on the Austrian policy and the practices concerning the management of spent fuel of the TRIGA research reactor in Vienna and the management of radioactive waste arising in Austria. Furthermore, it contains information on the Austrian national framework concerning the management of radioactive waste, applicable national laws, regulations and practices. The general structure of this report follows the “Guidelines regarding the Form and Structure of National Reports” (Infcirc/604/Rev.3).

This report includes also answers to questions received and raised at the country group session of the previous review meeting in 2018 and especially considers the progress of the future radioactive waste management concept at the only existing facility for radioactive waste management (Nuclear Engineering Seibersdorf (NES)). For more details regarding waste management at NES see Annex L1.

The Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) is the leading authority concerning the implementation of the obligations of this Convention.

B Policies and Practices – Article 32 Para 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 measure 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 to define and categorize radioactive waste

B1 Spent fuel management policy – Article 32 Para 1 (i)

In the 1970s, a nuclear power plant was constructed in Zwentendorf, but as a consequence of the negative vote in a referendum it was never put into operation. All nuclear fuel elements were removed in the late 1980s. Thus, Austria has never operated a nuclear power plant and has no intention to do so in the future. Austria's use of nuclear energy for peaceful purposes has significantly been influenced by the passing of the law prohibiting the use of nuclear fission for energy purposes in 1978 and by passing the Federal Constitutional Law for a Nonnuclear Austria in 1999. Currently, Austria operates one research reactor at the Institute of Atomic and Subatomic Physics, which is administered by the Vienna University of Technology.

In October/November 2012 – irradiated fuel elements from the research reactor were shipped to the Idaho National Lab and replaced by 77 standard TRIGA fuel elements, enriched to 19.8 %. Said fuel elements constitute a loan from the US Department of Energy (DoE) as stipulated in a contract between the Vienna University of Technology (TU WIEN), EURATOM and the DoE (contract No.DE-NA0001641). These fuel elements are to be returned to the USA in 2025. In case a clause to increase the term of the contract is

activated, the return shipment shall be 2035. Therefore, spent fuel management in Austria is limited to the interim storage of the spent fuel elements of the TRIGA Reactor which is currently empty.

B2 Spent fuel management practices – Article 32 Para 1 (ii)

Spent fuel from the TRIGA research reactor can be stored on site until the final return shipment to the United States. The dry interim storage with a capacity of 168 fuel elements is situated in the reactor building. At present, no spent fuel elements are stored there.

Storage of spent fuel is performed according to the relevant radiation protection and safeguards legislation. An appropriate licence is needed for the storage and annual inspections are performed by the licensing authority. Future shipment is performed according to the relevant transport and safeguards legislation.

B3 Radioactive waste management policy – Article 32 Para 1 (iii)

The Austrian Federal Constitutional Act for a Nonnuclear Austria prohibits any kind of handling of nuclear weapons and related facilities (§ 1) as well as the construction and use of facilities for production of energy by nuclear fission (§ 2) on the Austrian territory. In line with Austria's attitude towards nuclear power no facilities for spent nuclear fuel are in operation in Austria. Also no facilities for the management of HLW are in operation in Austria.

Radioactive waste mainly originates from applications of radioactive substances in medicine, industry, education and research. Low and intermediate level waste also originates wherever relevant facilities are decommissioned.

Austria has laid down its radioactive waste management policy in § 141 (1) to (4) of the Radiation Protection Act 2020. The basic principles are the following:

The Republic of Austria shall bear the ultimate responsibility for the safe management of radioactive waste arising in its territory. This basic principle underlines the national responsibility regarding radioactive waste management.

Possibilities of cooperation in the field of radioactive waste management with other Member States of the European Union or states that have ratified the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management have to be considered.

Whilst the construction and operation of research reactors in Austria is permitted, the operator of a research reactor must ensure that no spent fuel is left for disposal in Austria. This has to be achieved by means of a take back (return) agreement with the manufacturer or supplier of the fuel elements.

The minimization of radioactive waste is a basic principle when handling with radioactive substances in general and the management of radioactive waste in particular. This is based on ecological, ethical and safety-relevant considerations, given that the potential impact on the environment and the safety risk during treatment and storage increase with the amount of waste. The burden on future generations should be kept as low as possible. Furthermore, radioactive waste minimization together with volume reduction have important economic advantages, since treatment and disposal are costly and smaller amounts of waste volumes will result in lower costs.

Interdependencies between the different steps taken in the frame of radioactive waste management must be considered. The background of this principle is the close interlinking of the individual steps from generation to disposal, whereby decisions taken at any step can decisively influence the following step. Each individual management step should be analysed and designed so that they, and subsequent steps, are optimised. For example, conditioned drums should be dried before being placed in an interimstorage facility. The possibility of corrosion of the inside of the waste drums is largely prevented with this measure.

An important principle is that radioactive waste shall be managed safely: radioactive waste must be isolated from humans and the environment also in the long-term (in this respect, aspects of passive safety should be taken into account). Examples are the use of corrosion-resistant drums for the interim storage of conditioned radioactive waste or the design of a disposal facility in such a way that it can be left to itself after the closure, without risks.

The safety measures for a facility or an activity related to the radioactive waste management should be determined in a graded approach according to the risks. For

example, the requirements for disposal facility are much more extensive than for an interim storage facility.

A fact-based and documented decision-making process is applied to all radioactive waste management steps. The decision-making process shall be based on a summary of the arguments and facts demonstrating that the required standard for the safety of a facility or for an activity related to the management of radioactive waste has been achieved.

According to § 143 of the Radiation Protection Act 2020 NES is entrusted by the Republic of Austria with the predisposal management of the radioactive waste arising in Austria. This contract covers the collection, sorting, conditioning and interim storage of radioactive waste in Seibersdorf. The ongoing modernisation of the treatment and storage facilities provides the best technical conditions for a safe treatment, conditioning and interim storage. The costs for predisposal management as well as disposal of all radioactive waste are covered by the "polluter pays principle". The aim of this principle is cost recovery through the polluters, so as not to burden future generations with the costs. When radioactive waste is transferred to NES, the waste producer has to pay a fee for treatment and interim storage and, on the other hand, a pre-payment fee which the Federal Government may use as revenue exclusively for the purpose of financing a subsequent disposal facility.

Until a decision is made for disposing the radioactive waste, Austria stores the conditioned waste in the interim storage halls at NES. Waste treatment and interim storage at the Seibersdorf site is contractually guaranteed until 2045.

According to the European Waste Management Directive (Council Directive 2011/70/EURATOM for the responsible and safe management of spent fuel and radioactive waste) Austria has established a National Program for Radioactive Waste Management to ensure the implementation of all steps of spent fuel and radioactive waste management from generation to disposal. This program was subject of a Strategic Environmental Assessment according to § 142 of the Radiation Protection Act 2020.

In September 2018 the Austrian Federal Government approved this National Program for Radioactive Waste Management. Austria envisages to establish a working group according to this programme, called the Nationale Radioactive Waste Management Committee, consisting of representatives from ministries and federal provinces, independent experts, stakeholders and the civil society. This group will advise the federal government in questions regarding the disposal of the Austrian radioactive waste.

A decision on the location and type of the required disposal facility has not yet been taken in Austria. In addition to the clarification of the legal and organisational issues, it is above all necessary to ensure that the entire process is transparent. All important decisions must take place with the appropriate involvement of the public and interested institutions.

According to the present state-of-the-art, various types of disposal facilities are considered, which are suitable for different types of waste. Since Austria does not have to dispose HLW or spent nuclear fuel, the technical disposal requirements for the Austrian radioactive waste are lower than in countries with nuclear power plants. The safe disposal of short-lived radioactive waste, which makes up most of the waste volume, is possible in near surface disposal facilities. Such disposal facilities already exist in several countries of the world. Austria is striving for the timely establishment of a disposal facility for its radioactive waste in its own country.

In order to find a suitable solution for the small quantities of long-lived waste, the possibility of cooperation with other countries seems to be an option for discussion. In the international community, regional or international cooperation is regarded as a suitable option for disposal and there are corresponding initiatives for a common approach. The advantages and disadvantages of Austria's participation in a joint disposal facilty will have to be discussed in a transparent process.

B4 Radioactive waste management practices – Article 32 Para 1 (iv)

Nuclear Engineering Seibersdorf GmbH (NES) is the only centralised waste management facility in Austria. All conditioned low level and intermediate level radioactive waste (LILW) arising in Austria is currently stored in the interim storage facilities at NES. HLW does not arise in Austria.

Austria follows the principle of minimisation of radioactive waste. For this reason, radioactive waste with radionuclides with short half-lives is allowed to be stored by the producers until its activity has decayed below applicable clearance levels. Subsequently, this material, as inactive waste, can be either released to the environment or disposed as conventional waste. Another possibility is the controlled release or discharge of very small amounts of gaseous or liquid radioactive material in line with the requirements of an appropriate licence (§ 77 of the General Radiation Protection Ordinance). All other radioactive waste must be transferred to NES for treatment and conditioning.

The aim of treatment and conditioning is to transform the radioactive waste into a chemical stable form and to isolate it safely from the environment. The reduction of the volume of the waste is also necessary to lower the cost of interimstorage. Procedures are established to effectively minimise and monitor the releases of radioactivity in accordance with applicable environmental regulations, i.e. HEPA filtration of gas effluents from the incinerator. A comprehensive program of environmental monitoring is in place to ensure that any unintended releases of radioactivity are detected and that necessary actions can be made in a timely manner.

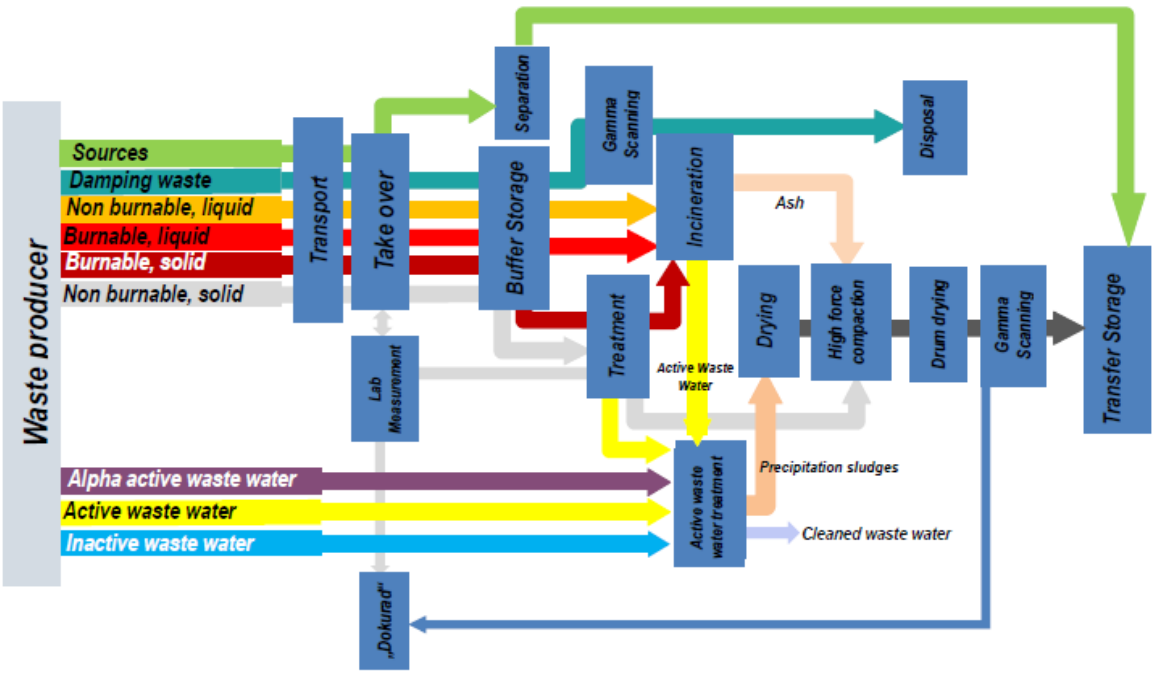
A number of conditioning systems are operated by NES (see also Annex L1).

Depending on the type of waste, several treatment techniques are applied:

- Combustible waste is incinerated. In the past, the resulting incinerator ash has been homogeneously cemented. Since 2007 ash is stored in 100-litre-drums which are placed into custom-made stainless-steel cartridges.
  So far, no adverse effects of drums with cemented ash have been noticed in inspections. Therefore, there was no need for an intervention so far. These drums with cemented ashes are part of the reconditioning project where some already have been reconditioned (23 drums with homogenous cemented ashes have been reconditioned so far in March 2020); volume reduction: > 40:1.
- Non-combustible compactable waste is supercompacted; the pellets are loaded into 200-litre-drums made of steel for interim storage, volume reduction: ~ 3:1.
- Liquids are either injected into the incinerator or dried in a vacuum cone dryer (usually after mixing with sludge from the wastewater treatment plant). The resulting powder is supercompacted; volume reduction: > 30:1.
- Filters are supercompacted; pellets are loaded into 200-litre-drums for interim storage.
- Conditioned 200-litre-drums are dried in the 32-drum-dryer to minimize the risk of corrosion effects and chemical reactions inside.
- Sealed sources are segregated according to their half-life (^{60}Co, ^{137}Cs, ^{241}Am). They are enclosed in stainless steel cartridges and/or lead shielding and retrievably stored in 200-litre-drums.
- Radium sources are encapsulated by welding them into stainless steel capsules; they are retrievably stored in lead shielding. Other sources are collected in small steel containers and stored in shielded drums.

- High-activity sealed sources can be handled in the hot cell facility and are stored in the storage tubes of the underground storage below the hot cell.
- Before the conditioned drums are transferred to the interim storage facility, they are characterized regarding radionuclide content with the waste assay system. This information is put together with all the data on the waste gathered throughout the waste management processes (the life-cycle of the waste) and also includes the customer information on the raw radioactive waste into one document which proves that the waste acceptance criteria for interim storage are upheld. This data is stored in an in-house developed waste management database called “Dokurad”. The checking of the combined results is done considering the four-eyes principle.

Figure 1 Schematic diagram of the streams of radioactive waste at NES, © NES



All radioactive waste management facilities and activities at NES are duly licenced and regularly supervised by the competent authority in accordance with the relevant radiation protection legislation (see section E).

B5. Categorisation of Radioactive Waste – Article 32 Para 1 (v)

Radioactive waste is defined in the Austrian legislation as radioactive material for which no further use is foreseen and which is regulated as radioactive waste by a regulatory authority. Radioactive material means any substance that contains one or more radionuclides the activity or activity concentration of which cannot be disregarded from a radiation protection point of view. Exemption and clearance levels are laid down in the General Radiation Protection Ordinance and are based on values recommended by the IAEA.

Effective from 1 January 2004, NES adopted the recommendation of 15 September 1999 on a classification system for solid radioactive waste 1999/669/EC, EURATOM. This radioactive waste classification system follows the IAEA classification scheme (Safety Series No 111-G-1.1) GSG 1:

- **Clearable waste:** Waste that meets the clearance criteria. This category corresponds to the "Exempt Waste" category according to IAEA GSG-1.
- **Transition radioactive waste:** Type of radioactive waste (mainly from medical origin) which will decay within the period of temporary storage (e.g. waste with half-lives less than 100 days) and may then be suitable for management outside of the regulatory control system subject to compliance with clearance levels.
  Waste in the transition phase i.e. short-lived decay waste from medical applications containing ^{125}I is left to decay at the producers' sites, i.e., hospitals, or is brought to NES for decay storage.
- This corresponds to the classification "VSLW" – Very short lived waste – according to IAEA GSG-1.
- **Low and intermediate level waste (LILW):** In LILW, the concentration of radionuclides is such that generation of thermal power during its disposal is sufficiently low. These acceptable thermal power values are site-specific following safety assessments.
  - **Short-lived waste (LILW-SL):** This category includes radioactive waste with nuclides half-life less than or equal to those of ^{137}Cs and ^{90}Sr (around 30 years) with a restricted alpha long-lived radionuclide concentration (limitation of long-lived alpha emitting radionuclides to 4000 Bq/g in individual waste packages and to an overall average of 400 Bq/g in the total waste volume).
  - For classification purposes at NES internal waste-acceptance criteria for interim storage uses the limit of 400 Bq/g of long-lived alpha emitting radionuclides per waste package (instead of 4000 Bq/g per package).

- **Long-lived waste (LILW-LL):** Waste with alpha long-lived radionuclides whose concentration exceeds the limits for short-lived waste. [1]

- **High level waste (HLW):** Waste with levels of activity concentration high enough to generate significant quantities of heat by the radioactive decay process or waste with large amounts of long-lived radionuclides that need to be considered in the design of a disposal facility. HLW does not arise in Austria.

[1] The IAEA GSG-1 recommends 400 Bq/g of long-lived alpha nuclides on average and up to 4000 Bq/g in individual waste containers as a limit between LLW and ILW. The same value is used in Austria as the boundary between LILW-SL and LILW-LL.

C Scope of Application – Article 3

Reprocessing – Article 3 Para 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.

There is no reprocessing facility in Austria.

Waste containing only NORM – Article 3 Para 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 is declared as radioactive waste for the purpose of this Convention by a Contracting Party.

The Austrian legislation defines the conditions under which naturally occurring radioactive material falls under the provisions of the radiation protection legislation. If such material is declared as radioactive waste, it is subject to the same requirements as other radioactive waste and is considered to be radioactive waste for the purpose of the Convention.

This kind of radioactive waste cannot be conventionally disposed. It has to be sent to NES for treatment, conditioning and interim storage. At present there are no large amounts of such waste arising in Austria.

Radioactive waste from defence programs – Article 3 Para 3

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

The Austrian legislation applicable for radioactive waste management makes no difference for the regulation of radioactive waste originating from civilian or military applications. Only a small amount of radioactive waste (from time to time some disused sealed sources) originates from military applications. It has been sent to NES for treatment, conditioning and interim storage. Radioactive Waste from military applications basically comprises small disused sealed sources used for training purposes.

D Inventories and Lists – Article 32 Para 2

This report shall also include:

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

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

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

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

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

(b) has been disposed of; or

(c) has resulted from past practices.

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

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

D1 Spent fuel management facilities

There are no spent fuel management facilities in Austria since Austria does not operate nuclear power plants. As stated in chapters B1 and B2, spent fuel elements from the only operating research reactor will be returned to the USA according to a contract between the United States Department of Energy, the Vienna University of Technology and EURATOM.

There is an interim storage at the site of the reactor in the Institute of Atomic and Subatomic Physics, which is administered by the Vienna University of Technology (see below), available, which is currently empty ever since the core conversion in October 2012.

D2 Inventory of spent fuel

No spent fuel elements are actually in interim storage at the research reactor of the Institute of Atomic and Subatomic Physics of the Vienna University of Technology.

D3 Radioactive waste management facilities

NES is the only radioactive waste management facility in Austria. This limited liability company with a controlling majority stake owned by the Austrian Government is located at the Seibersdorf site south of Vienna.

NES is responsible for the collection, treatment, conditioning and interim storage of all radioactive waste generated in Austria. The following treatment, conditioning and waste handling facilities are in operation:

- LILW incinerator (capacity: about 40 kg/h solid burnable waste)
- High force compactor
- Wastewater treatment facility (precipitation, filtration)
- Sludge dryer
- Cementation equipment
- Drum drying facility
- Waste assay system
- Hot-cell facility
- Buffer storage facilities for raw radioactive waste
- Interim storage facilities for conditioned radioactive waste.

Currently a comprehensive modernisation project of the different facilities at NES is ongoing, major parts are already completed. For more details of the different waste management facilities at NES and the modernisation see Annex L1.

There are no disposal facilities for radioactive waste in operation in Austria.

D4 Inventory of radioactive waste

As Austria has neither nuclear power plants nor uranium mines or any other nuclear fuel cycle facilities, no HLW is produced in Austria. The main sources of LILW are the use of radioactive material in medicine, industry and research (approximately 15 tons/year) as well as the ongoing decommissioning and dismantling activities of former nuclear research facilities (30-110 tons/year).

The annual quantity of incoming/raw waste is largely depending on the ongoing decommissioning projects. Usually a large part of this waste can be decontaminated and cleared, while only a small part ending in the interim storage as conditioned radioactive waste. Therefore, the resulting amount of conditioned waste is in maximum approx. 250 drums (200 l) per year.

The activity inventory and waste volume present at the NES interim storage facility (end of 2019):

- total activity of short-lived waste (LILW-SL): ~ 9.94E+15 Bq[2], approx. 2360 m³
- total activity of long-lived waste (LILW-LL): ~ 4.57E+12 Bq, approx. 60 m³

The major amount of solid waste is material from decommissioning or dismantling activities and combustible waste from the use of radioactive material in medicine. Liquid waste mainly originates from the operation of waste treatment facilities (e.g. NES incinerator's wet scrubber) and radionuclide laboratories on the Seibersdorf site. A small fraction of liquid waste originates from medical facilities and universities.

Sealed sources such as ^{60}Co, ^{137}Cs, ^{241}Am and others are widely used for industrial purposes. Sources containing ^{60}Co and ^{137}Cs are used for medical applications as radiation sources for high dose treatment (few in number, but with high activities). Special categories are radium sources used from around 1900 to about 1960 for medical treatment. They were produced in different qualities and some showed a tendency for leakage. Due to the high radiotoxicity of radium, their usage was discontinued and they

[2] Activities as per reference date. Reference date for these activities is the entry date of the respective raw waste.

were replaced by safer sources as soon as available. More than 14 g of radium were conditioned and are stored in the interim storage facility.

Naturally Occurring Radioactive Material (NORM) originating from different industrial processes has been treated and conditioned at NES until 2006. Since 2008, the treatment of residues originating from handling of NORM is regulated by the General Radiation Protection Ordinance in compliance with international recommendations and regulations. Only NORM waste which is declared as radioactive waste, is treated by NES (see section C).

Relevant industrial practices in Austria where NORM-wastes can arise are:

- Extraction of rare earth elements
- Oil and gas production (only in a few cases radiologically relevant)
- Production of phosphate fertilizers
- Ground water filtration facilities (industrial or commercial use of materials having high contents of Uranium or Thorium e.g. use of abrasives for sandblasting)
- Deep geothermal energy production
- Radon spas

At the end of 2019, there have been 11 816 mainly 200-litre-drums containing conditioned radioactive waste in the interim storage facility, as well as five "*Mosaik©*" containers and five "*Konrad Type II*" containers with radioactive waste from the decommissioning project of the former ASTRA reactor.

D5 Nuclear facilities in the process of being decommissioned

Decommissioning of the old storage facility for radioactive waste (sources) at the NES site - mentioned in the previous report - has been completed in 2017. The second decommissioning project – a former storage building for radioactive waste – has been finished as well in the same year.

In addition, work has proceeded for the decommissioning of the old hot-cell laboratory, which should be finished within the next 5 years.

E Legislative and Regulatory System

E1 Implementing Measures – Article 18

> 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.

As described below in Sections E 2 and E 3, Austria has taken legislative, regulatory and administrative measures for implementing its obligations under the Joint Convention.

E2 Legislative and Regulatory Framework – Article 19

Overview – Article 19 Para 1

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

The safety of spent fuel management and the safety of radioactive waste management are mainly governed by the federal legislation on radiation protection, consisting of the following laws and ordinances:

- Radiation Protection Act 2020 (a new codification on measures to protect against dangers from exposure from ionising radiation, in force since 1 August 2020),
- General Radiation Protection Ordinance 2020 (a new codification on general measures to protect against dangers from ionising radiation, in force since 1 August, 2020),
- Ordinance on Interventions in Case of Radiological Emergencies 2020 (with amendments, in force since 1 August 2020),
- Ordinance on the Shipment of Radioactive Waste (with amendments, in force since 1 August 2020).

Now the new regulatory framework covers the latest requirements of the EURATOM Council Directives for radiation protection, radioactive waste management and nuclear safety.

Regarding radioactive waste management the Radiation Protection Act 2020 covers

- general principles of the national policy (including the requirement of the prime responsibility of the licence holder for the safety of a waste management facility),
- provisions for a national radioactive waste management program,
- provisions for a self-assessment and peer reviews and
- requirements for public participation in the decision making process.

The General Radiation Protection Ordinance 2020 addresses the following requirements:

- provisions for the construction, operation and decommissioning of radioactive waste management facilities,
- provisions for the organisation and for the safety of radioactive waste management facilities (supplemented by measures to promote and improve the safety culture),
- provisions for record keeping and obligations for notifications to the competent authority,
- requirements for radiation protection officers,
- provisions for the information of the public regarding radioactive waste management.

Specific requirements for the construction, operation and decommissioning of radioactive waste management facilities are prescribed in detail in the licences. National and international norms and standards (for construction and operation of the radioactive waste management facilities, requirements for radiation protection and radioactive waste management) are prescribed in the licences of the licence holders.

Radiation Safety - Article 19 Para 2 (i)

This legislative and regulatory framework shall provide for the establishment of applicable national safety requirements and regulations for radiation safety.

Requirements for radiation safety are determined in the Radiation Protection Act 2020, the General Radiation Protection Ordinance 2020 and the Ordinance on Interventions in Case of Radiological Emergencies 2020 with the aim to protect lives and health of individuals and their descendants, as well as the environment from the hazards of ionising radiation. It implements the principles of justification of a practice, optimisation of radiation exposure and dose limitation. Detailed and specific radiation protection

measures for the predisposal management of radioactive waste are additionally laid down in the construction and operation licences.

Beyond these specific regulations, the General Administrative Procedures Act from 1991 and related instruments subsequently apply to the licensing procedures.

These requirements are in line with the standards on radiation protection agreed on international level. More detailed criteria concerning radiation protection and radiation safety are defined in the individual licences.

Licensing System – Article 19 Para 2 (ii)

This legislative and regulatory framework shall provide for a system of licensing of spent fuel and radioactive waste management activities.

As a result of the Austrian federal structure, there are federal and regional authorities involved in the different radiation protection licensing procedures. The different responsibilities are laid down in § 153 of the Radiation Protection Act 2020. Concerning the management of radioactive waste, the BMK is the competent authority to lay down provisions for the safe management of radioactive waste at NES. The same federal authority is also responsible for granting licences for the construction, operation and decommissioning of facilities for the treatment, conditioning, interim storage and disposal of radioactive waste as well as amendments to them.

The process of licensing, which is also applied for the management of radioactive waste, is laid down in the Radiation Protection Act 2020 where the relevant provisions state that a licence is required for practices that can increase the exposure of individuals to radiation from a radiation source.

Among the prerequisites for granting a licence for radioactive waste management facilities, the protection of human health and the environment as well as the operator's obligation for meeting all the requirements must be demonstrated.

In general the licensing procedure for practices, where constructional measures for radiation protection are necessary, consists of two stages. In the first stage the operator has to apply for a construction licence (§§ 15 and 16 Radiation Protection Act 2020).

Additional requirements for the construction of radioactive waste management facilities are prescribed in § 53 (1) of the Radiation Protection Act 2020:

- the the site selection has to be done in accordance with international recognized safety standards,
- the radioactive waste management facility has to be designed according to the state of the art and international recognized standards,
- a preliminary safety report and a preliminary on-site emergency plan have to be available.

The operator has to send all necessary documents to the competent authority for the application of a construction licence. A licence is granted if the intended construction complies with all specific obligations of the radiation protection legislation and if the planned radiation protection measures are adequate.If new insights were gathered in the frame of the construction or if there are new scientific evidences additional measures can be prescribed at any stage of the construction.

In the second stage the operator has to apply for an operational licence according to §§ 15 and 17 of the Radiation Protection Act 2020. Additional requirements for the operation of radioactive waste management facilities are prescribed in § 53 (2) of the Radiation Protection Act 2020 such as

- the availability of adequate technical, human and financial resources for safe operation,
- the availability of a safety report and an on-site emergency plan,
- the establishment of an integrated management system as well
- the availability of a decommissioning concept.

An operation licence is granted if the installation has been constructed in compliance with the specified conditions and obligations, a radiation protection officer has been appointed and the regular operation of the installation entails no hazard from ionising radiation. Additional radiation protection measures can be prescribed at any stage of the operation if there are new findings Accrued rights of the licenceholder must be duly respected.

Furthermore, prerequisites for the issuing of a **licence for the decommissioning** of radioactive waste management facilities according to §§ 15, 17 and 53 (3) Radiation Protection Act 2020 are

- the availability of detailed planning for decommissioning in accordance with the state of the art and international recognized safety standards based on the current decommissioning concept,
- the availability of adequate technical, human and financial resources for decommissioning as well
- the availability of a safety report and an on-site emergency plan.

Prohibition of operation without a license – Article 19 Para 2 (iii)

This legislative and regulatory framework shall provide for a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence.

The Radiation Protection Act 2020 requires a licence for the construction, operation or decommissioning of a radioactive waste management facility and explicitly prohibits to carry out a practice without an appropriate licence. There are no exceptions to this requirement.

Control, regulatory inspection, documentation and reporting - Art 19 Para 2 (iv)

This legislative and regulatory framework shall provide for a system of appropriate institutional control, regulatory inspection and documentation and reporting.

In general all facilities which are licenced according to the Radiation Protection Act 2020 have to be inspected at regular intervals by the competent authorities (§§ 61, 62 Radiation Protection Act 2020). If necessary, the licence holder can be requested to implement additional radiation protection measures as an outcome of the inspection.

The practices of NES and the research reactor are inspected at least every year by the competent authorities.

The radiation protection legislation requires comprehensive documentation on the construction, modification and operation of facilities and for the handling of radioactive material. Detailed specifications on documentation and reporting are set forth in the regulations and, if necessary in the individual licences.

Enforcement – Article 19 Para 2 (v)

This legislative and regulatory framework shall provide for the enforcement of applicable regulations and of the terms of the licences.

The competent regulatory authorities are also in charge of enforcing the legislation and the regulations applicable to facilities for the use of radioactive material as well as the obligations of the licenceholder. They are empowered to take the necessary enforcement measures.

According to §§ 61 and 62 of the Radiation Protection Act 2020 the authority who has granted the licences can carry out inspections at any time. The inspections have to include compliance with the relevant provisions of the law, all the administrative acts issued for this purpose and the directly applicable relevant EU legal acts. For the case that a radiation protection regulation has been violated by the licence holder, the regulatory body must request the licence holder to restore a state that complies with all the radiation protection regulations within a reasonable period. Otherwise the competent authority has to report that to the competent administrative criminal authority. These authorities on the district administrative level have in general the jurisdiction in administrative penal matters and proceedings (Art. 26 Administrative Penal Act 1991).

The operation, the handling or the use may only be continued if the authority had determined that the deficiency leading to the prohibition has been remedied. In events of imminent danger, due to the handling of sources, the authority has to arrange for all appropriate measures to avert this danger. For this purpose, the authority can act in accordance with the provisions of the Administration Enforcement Act 1991 in order to shut down and stop unsafe installations or withdrawal existing licences (§§ 21, 22 Radiation Protection Act 2020).

According to the Radiation Protection Act 2020, anyone who intends to construct or operate an installation for the handling of radioactive material without an adequate licence commits a crime and is fined with an administrative penalty of up to 50.000 Euro. Anyone not fulfilling requirements or obligations of its licence is charged with an administrative penalty of up to 1.500 Euro, in the event of repetition up to 2.250 Euro. The range of punishment is laid down in § 152 of the Radiation Protection Act 2020. Even the attempt is punishable. The enforcement procedure is primarily laid down in the Administrative Penal Act. The provisions found in the General Administration Procedures

Act and in the Administrative Enforcement Act are subsidiarily applicable to administrative penal procedures.

Allocation of Responsibilities – Article 19 Para 2 (vi)

This legislative and regulatory framework shall provide for a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

The Republic of Austria is responsible for the safe management of radioactive waste arising in Austria. For this purpose, the Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) has been authorised in the past to conclude contracts with an appropriate institution (which is NES) obliging them to treat all radioactive waste arising in Austria.

Hence, the Republic of Austria (represented by BMK), the municipality of Seibersdorf and NES concluded an agreement. NES is obliged to collect, treat, condition and interim store all radioactive wastes arising in Austria according to this agreement until the end of 2045. On the other hand, the Republic of Austria guarantees NES the necessary financial provisions for their technical infrastructure and for important projects like the reconditioning of old conditioned drums of radioactive waste.

Regulating Radioactive Materials as Radioactive Waste – Article 19 (3)

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

According to the definition of the Radiation Protection Act 2020 radioactive waste is defined as follows:

Radioactive waste means any radioactive material that

- is not intended for further use and
- is subject to an official control as radioactive waste.

Exemption and clearance levels are laid down in the General Radiation Protection Ordinance 2020 as nuclide specific values derived from the internationally accepted 10 µSv/year dose concept. Clearances have to be authorized by the competent authority.

E3 Regulatory Body – Article 20

Establishment and Designation – Article 20 Para 1

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

The BMK is the competent licensing and supervisory authority for the management of radioactive waste – in particular for NES, the only waste management facility in Austria. Thus, in the field of the safety of radioactive waste management, the regulatory body entrusted with the tasks of the implementation of the legislative and regulatory framework (see E2) is the BMK.

The competencies for radiation protection in general are divided between different authorities in Austria due to the federal and regional structure:

The **Federal Ministry of Education, Science and Research** (BMBWF) is the competent authority for the licensing of the construction and operation as well as for the inspection of university-based accelerators on the one hand and for the licensing of the construction and operation as well as for the inspection of research reactors on the other hand until the end of 2020 (the TRIGA Mark II Reactor of the Vienna University of Technology is currently the only research reactor in operation, there are no plans to build new research reactors in the future). These competencies will move to the **BMK** with the beginning of 2021. The **Federal Ministry of Social Affairs, Health, Care and Consumer** is responsible for radiation protection in the medical field and with regard to foodstuff. The **Federal Minister of Justice** is responsible for all legal matters relating to the Nuclear Liability Act. The **Governors of the Federal Provinces** are the common radiation protection authorities for remaining matters and responsible for licensing and supervision according to the

Radiation Protection Act 2020. They also issue licences according to the Environmental Impact Assessment Act.

Regular meetings (usually every year) between federal and regional authorities are held for exchanging knowledge.

Independence – Article 20 Para 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 organisations are involved in both spent fuel or radioactive waste management and in their regulation.

The regulatory task in the field of management of radioactive waste resides within the Austrian Federal State represented by the BMK, which is the licencing and regulatory authority for the construction and operation of radioactive waste management facilities. According to the agreement between the Republic of Austria (represented by BMK), the municipality of Seibersdorf and NES, the necessary financial resources for the infrastructure and equipment of the NES are guaranteed by the Austrian State. The financial ressources of NES are agreed by the Federal Minister of Finance and are a separate part of the budget of the BMK. It is administered by BMK but supervised by the Minister of Finance (for more details see chapter F2).

The Vienna University of Technology is a fully autonomous entity of higher education and research under Article 81c of the Austrian Federal Constitutional Law. It has its own global budget since 1 January 2004 and is the licensee for the TRIGA Mark II Research Reactor situated at the Atomic und Subatomic Physics Institute. The global budget of the university is negotiated with the BMBWF every third year and supplied by the Ministry of Finance. Therefore the BMBWF has no undue influence on any decisions the Vienna University of Technology may make as the licence holder and can fulfil its duty as regulatory authority unbiased and according to the law.

Regardless, the effective independence of the BMBWF as regulatory body for the TRIGA reactor might be compromised, despite the aforementioned legal framework for safety, as the BMBWF also provides the funding to the TU Wien. This duality is capable to potentially cause a conflict of interest.

While this setup has so far had no effect on the performance and on the decisions of the regulatory body or on the generally very high level of safety, it might have an impact on the independent decision-making processes in the future.

This potential conflict of interest has been addressed in Austria's IRRS Mission Report in 2018. Therefore, steps were taken to resolve the situation by means of making provisions in the Radiation Protection Act 2020, which entered into force on 1 August 2020. The new Act transfers the competence for the regulatory oversight for radiation protection to the BMK on 1 January 2021, at which time the potential conflict of interest regarding regulatory oversight over the TRIGA Research Reactor will be resolved and effective independence will be ensured.

F Other General Safety Provisions

F1 Responsibility of the license holder – Article 21

License Holder – Article 21 Para 1

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

Predisposal management of radioactive waste is carried out by NES. Every practice of NES is licenced and supervised by the BMK.

The Radiation Protection Act 2020 clearly states in § 141 (5) that the licence holder of a radioactive waste management facility is responsible for the safety of the facility and its operation. The specific obligations of the licence holder resulting from that fundamental responsibility are listed in the Radiation Protection Act 2020 and further elaborated in the General Radiation Protection Ordinance supported by relevant standards and guidelines on radiation protection and radioactive waste management.

The BMK is the main regulatory body in the field of the safety of radioactive waste management. The Federal Minister has the necessary authority and competence to fulfil his enforcement functions. The Federal Ministry carries out inspections at least annually to assure that the licence holder of the waste management facility meets its responsibilities and obligations.

With respect to the research reactor of the Institute of Atomic and Subatomic Physics of the Vienna University of Technology, a decommissioning concept was submitted by the licence holder to the competent authority. This includes the shipment of the spent fuel to its country of origin (US) under the supply contract DE-NA0001641 between the Vienna University of Technology, the US Department of Energy and EURATOM-ESA. Interim storage for spent fuel is available on site at the research reactor but currently empty. Any radioactive waste produced during decommissioning will be sent to NES. Financial provision for the future decommissioning has to be provided by the Vienna University of

Technology and the Federal Real Estate Limited Company ("*Bundesimmobiliengesellschaft, BIG*") as owner of the property and the building the reactor is situated at.

Unlicensed Facilities, Activities and Materials – Article 21 Para 2

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

In the Radiation Protection Act 2020, orphan radioactive sources are defined as "radioactive sources which are subject to authorisation or at least registration and which are not under regulatory control either

- because they never have been under regulatory control or
- because they have been abandoned, lost, misplaced, stolen or
- because they have been transferred to a new holder, without proper notification of the competent authority, or without informing the recipient"

§ 138 of the Radiation Protection Act 2020 lays down the relevant provisions for the finding of orphan sources. The competent radiation protection authorities (in general the District Authorities) have to confiscate orphan sources and have to check who is responsible for the source. For the case that an owner cannot be found, the confiscating authority has to take care for a safe disposal of the radioactive source.

F2 Human and financial resources – Article 22

Qualified Staff – Article 22 (i)

Each Contracting Party shall take the appropriate steps to ensure that qualified staff is available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility.

The Radiation Protection Ordinance requires persons, who are directly entrusted with tasks in the field of radioactive waste management, to have relevant knowledge and training before starting their work. The qualified staff has to provide evidence of advanced training on radioactive waste management at intervals of five years.

The competent authority verifies these requirements for qualified staff in the frame of the annual inspections.

Furthermore the licence holder has to promote the ability at all levels of staff and management

- to question whether the relevant safety principles and practices are effectively performing their function, and
- to report security problems, and
- to take precautions for the registration, evaluation and documentation of internal and external safety-relevant operating experience.

The designation of a radiation protection officer is required for a practice according to the Radiation Protection Act 2020. A radiation protection officer is a qualified person who has been designated by the licence holder to take over duties and responsibilities regarding radiation protection matters and who is nominated to the competent authority. The duties of the radiation protection officer are laid down in the Radiation Protection Act 2020. If necessary, the licence holder must provide for a sufficient number of radiation safety officers or other safety related staff and proof of their qualifications.

Adequate Financial Resources – Article 22 (ii)

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

According to § 143 of the Radiation Protection Act 2020 there is an agreement between the Republic of Austria (represented by BMK), the Municipality of Seibersdorf and NES in place.According to this agreement NES has to collect, treat, condition and (interim) store the arising radioactive waste from Austria until the end of 2045. This agreement also ensures the necessary financial resources for the infrastructure and the equipment of NES by the Austrian State.

The responsibility of the Austrian State for disposing all radioactive waste which is interim stored at NES ensures the availability of sufficient financial resources for the construction and operation of a disposal facility.

As stated in chapter E3 the Research Reactor is operated by the Vienna University of Technology, who as a fully autonomous institution receives its own global budget for a three year period. In the current performance agreement between the Federal Ministry of Science, Research and Economy and the Vienna University of Technology the Vienna University of Technology is obligated under article B2.3.1 to ensure the implementation of all requirements laid down in the Radiation Protection Act 2020 in regard to infrastructural and safety measures, which includes the intermediate storage of spent fuel elements.

According to § 143 (3) of the the Radiation Protection Act 2020, the treatment of radioactive waste is financed according to the polluter-pay-principle. When the radioactive waste is delivered to NES, a charge for the predisposal management of the radioactive waste at NES has to be paid on the one hand ("Behandlungsentgelt") by the polluter. On the other hand the polluter also has to pay a charge for the disposal of its radioactive waste in the future ("*Vorsorgeentgelt*"). This "disposal fee" is calculated based on the costs of existing foreign disposal facilities and goes into a special separated fund which is not part of the state budget and is administered by Austrian authorities. This fund is exclusively dedicated for financing the future disposal facility. The tariffs are annually revised and adopted by the BMK. However, should the collected fund at a later period of time be insufficient to finance a disposal facility, the Austrian State would cover the difference.

Financial Provision for Institutional Controls – Article 22 (iii)

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

Since there are no disposal facilities in operation in Austria, there are no special requirements laid down in the legislation. However, according to the existing legislation, such a facility could only be closed, if the permanent protection of human life and health and of their descendants and of the environment is ensured.

F3 Quality assurance – Article 23

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.

NES has implemented an integrated management system (consisting of three regulations namely ISO 45001:2018, ISO 9001:2015 and ISO 14001:2015) which requires regular external and internal audits.

F4 Operational radiation protection – Article 24

The new Radiation Protection Act 2020 and the new General Radiation Protection Ordinance form the legal basis for operational radiation protection in Austria. This legislation aims at protecting human life and health and the environment against ionising radiation. It is based on the recommendations of the International Commission on Radiological Protection (ICRP) and implements the internationally agreed principles of justification of a practice, optimisation of radiation exposure and dose limitation. The requirements of the EU-BSS 2013/59/EURATOM are transposed in the radiation protection legislation with the new act and ordinance. Further radiation protection requirements are defined in national standards and specific obligations are stated in the construction and operation licences granted to each operator of a facility. All activities must be performed in accordance with radiation protection regulations.

Radiation Exposure – Article 24 Para 1(i)

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

The radiation protection legislation requires optimisation in line with the ALARA principle as a fundamental principle for limiting the radiation exposure of the workers and the public (§ 5 of the Radiation Protection Act 2020). It is the responsibility of the licence holder to implement measures for optimisation and to implement a system for control. In

the frame of the annual inspections according to § 61 of the Radiation Protection Act 2020 the competent authority also controls how optimisation is implemented.

Radiation Doses – Article 24 Para 1 (ii)

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

According to the Radiation Protection Ordinance, the dose limit for the public exposure is set to 1 mSv per year and the dose limit for occupational exposure to 20 mSv per year. These dose limits are in line with international standards. The Ordinance defines some dose constraints to ensure that the dose limits are not exceeded. The dose limits for apprentices aged between 16 and 18 years are laid down in § 4 of the General Radiation Protection Ordinance.

The NES employees have to undergo a training on handling radioactive materials and they are equipped with personal protective devices and dosimeters. Exposed workers of "category A" take part in a medical monitoring program. Handling of spent sealed sources is carried out in a lead cell. High activated sealed sources are handled in a hot cell facility.

The average effective dose – including external background radiation - for all personnel involved in radioactive waste management is reported in the table below.

Table 1: The average effective dose – including external background radiation - for all personnel involved in radioactive waste management

Year	max. Dose [mSv/y]	ex. Background [mSv/y]
2017	1.12	0.86
2018	1.38	0.78
2019	1.58	0.74

Preventive measures taken – Article 24 Para 1 (iii)

Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.

The release limits for the waste management facilities are laid down in the frame of the licensing process. Annual inspections ensure the compliance of the operator of the facility with the legal, licenced and administrative requirements. If the regulatory authority is of the view that a safe operation is not ensured the authority can take steps to immediately stop the operation of the facility.

Releases under normal conditions and potential releases during abnormal conditions from the facilities at NES are very low (transboundary emergencies cannot occur).

Radiation Exposure and Radiation Doses Due to Discharges – Article 24 Para 2

(vii) 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.

(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.

In the licence application for the construction and operation of a facility the technical measures, i.e., barriers and air filters, taken to reduce exposure from radioactive discharges must comply with the ALARA principle. These measures are explicitly stated as obligations when granting the licence. The release of radionuclides from the waste management facility to atmosphere and water bodies is monitored by the licence holder and surveyed by the competent authority. The inspection of the facilitiy by the authorities concerning discharges is set up of two parts: inspection of the quality of the internal control by the operator and independent surveillance by examination of samples taken by the technical support organisation of the authority.

The highest effective doses for the members of the public within a radius of 1 km due to discharges to the atmosphere and the water body from radioactive waste management facilities at NES are summarized in the table below.

Table 2 Effective dose due to discharges to the atmosphere and the water body

Year	Atmosphere [µSv]	Water body [µSv]	Sum [µSv]
2017	1.57E-2	2.58E-1	2.74E-1
2018	1.59E-2	3.05E-1	3.21E-1
2019	9.35E-3	5.33E-1	5.42E-1

The dose calculation was performed using the "Allgemeine Verwaltungsvorschrift" to § 47 of the German radiation protection act for liquid discharges and the "AUSTAL 2000" Software package for gaseous discharges, using the monitored activity concentrations as shown in the tables below.

Table 3 Activity concentration in water discharged to the water body

Year	Alpha [Bq/l]	Beta [Bq/l]	^{3}H [Bq/l]
2017	1.13E0	3.02E0	8.45E2
2018	4.8E-1	1.1E0	1.8E1
2019	3.8E-1	2.2E0	1.5E2

Table 4 Activity concentration in air discharged to the atmosphere

Year	Alpha [Bq/m^{3}]	Beta [Bq/m^{3}]	^{3}H [Bq/m^{3}]	^{14}C [Bq/m^{3}]
2017	9.7E-1	2.58E0	1.87E4	8.98E3
2018	7.1E-1	2.45E0	1.1E4	2.0E3
2019	6.3E-1	2.83E0	4.53E3	8.81E2

At the Institute of Atomic and Subatomic Physics, Vienna University of Technology, the average yearly dose of atmospheric release (mainly ^{41}Ar of the research reactor) and the

average yearly dose of wastewater stayed below 0.02 mSv since the founding of the Institute.

In general investigative measurements by the authorities of gaseous and liquid emissions and the internal surveillance by the operators show that maximum permissible levels never were exceeded. Additionally environmental monitoring in the surroundings did not detect any inadmissibly high gamma dose rates or immissions.

F5 Emergency preparedness – Article 25

Facility Emergency Plans – Article 25 Para 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.

On-site Emergency Plans

On site Emergency Preparedness and Response is part of the licensing procedure according to the Radiation Protection Act 2020 and the General Radiation Protection Ordinance, both updated by new versions in 2020 transposing the Basic Safety Standards (Directive 2013/59/EURATOM) into Austrian legislation.

Prior to the start of the construction the design of installations for handling of radioactive materials and radiation emitting devices with a higher potential threat, such as a radioactive waste management facility needs to be licenced according to §§ 15, 16 and 53 of the Radiation Protection Act 2020. This construction licence facilitates the subsequent licensing procedure for operation and requires among other documentation a preliminary safety report and a preliminary on-site emergency plan for the specific site.

In a second step the facility needs the operation licence in accordance with §§ 17and 53 of the Radiation Protection Act 2020. A final safety report and a final on-site emergency plan is among other documentation a precondition for the operation licence. The safety report as well as the on-site emergency plan has to be approved by the licensing authority.

The licensing requirements including the emergency plans are reviewed in the frame of the annual inspections. During these inspections the licensing authority can order the updating of emergency plans, if necessary.

More detailed requirements regarding the content and structure of the on-site emergency plan and conducting of emergency exercises for the centralised waste management facility NES are part of the new General Radiation Protection Ordinance 2020. The on-site emergency plan had a major update in 2015 and since 2015 it has been reviewed and updated every year by NES.

Emergency exercises for testing the on-site emergency plan:

In advance NES has to develop yearly exercise plans, which cover different events. The exercise plans have to be sent in advance to the licensing authority which will participate in specific exercises. The exercise plan typically includes 8-10 different exercises and training events such as fire alarms, flooding and medical treatment of contaminated personal.

In addition the plant fire brigade of the Seibersdorf site performs about 20 fire drills each year. At least 15 of these drills are held directly in the buildings and facilities, including the incinerator plant, the water treatment plant and the hot-cell laboratory of NES.

Additional requirements concerning evaluating exercises and the participation of the regulatory body in exercises are also be part of the amended General Radiation Protection Ordinance.

In regard to the TRIGA Mark II Reactor the on-site emergency plan is included in the safety report. This includes emergency plans in regard to the fuel elements and radioactive waste, The Vienna University of Technology regularly revises the safety report, which is in turn reviewed by the regulatory authority. The latest revision took place in 2020.

Off-site Emergency Plans

Off-site emergency plans were updated based on the Radiation Protection Act 2020 and the new version of the Ordinance on Interventions in Case of Radiological Emergencies 2020. These plans are also in accordance with the recommendations of the IAEA document GSR Part 7 taking into account different events which could cause radiological emergencies in Austria such as events with dangerous radiation sources, events in nuclear

facilities outside of Austria, satellite re-entry with radioactive sources on board and malicious / terroristic acts.

One of these off-site emergency plans focuses on events in Austrian facilities operating with dangerous sources. Among others accidents in the central radioactive waste management and interim storage facility – NES are taken into account. Since NES is an IAEA emergency preparedness category III facility urgent protective actions could only be necessary on-site. Nevertheless other actions such as information of the public, coordination of authorities, sampling and measurements off-site, etc. have to be prepared for the event of a radiological emergency. The Radiation Protection Act 2020 also provides requirements on the periodic testing of the emergency plans by conducting emergency exercises. Lessons identified from exercises and the operating experience have to be taken into account in periodic reviewing and updating of the emergency plans.

National and International Notification

In accordance with § 57 of the Radiation Protection Act 2020 a radiological emergency in an Austrian facility has to be immediately notified to the licensing authority by the licencee. Information on the causes of the accident and the possible consequences have to be provided for by the licencee. Additional notification and information requirements for radiological emergencies on Austrian territory are part of Radiation Protection Act 2020 and the Ordinance on Interventions in Case of a Radiological Emergency 2020.

In addition detailed criteria for notification and information in case of incidents, accidents and emergencies for different practices are part of the General Radiation Protection Act 2020 and the General Radiation Protection Ordinance.

In case of an event which has to be notified according to the Early Notification Convention and according to Council Decision 87/600/EURATOM (ECURIE), BMK is the competent authority for the notification to the respective international organisations. Provisions for national and international notification are a central part of the off-site emergency plan.

Territory Emergency Plans – Article 25 Para 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.

Off-Site EPR Organisations and Responsibilities

BMK takes action in case of any radiological emergency coming from abroad. For the different responsibilities in the field of off-site emergency preparedness for events outside Austria as well as in Austria see the table below:

Table 5: Responsibilities for off-site EPR

Organisation	Responsibilities
Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)	• evaluation of the consequences of radiological and nuclear emergencies and decisions on protective actions in cooperation with Federal Ministry of Social Affairs, Health Care and Consumer Protection • environmental monitoring • Competent Authority for international information exchange (ECURIE, IAEA Convention on Early Notification and bilateral agreements)
Federal Ministry of Social Affairs, Health, Care and Consumer Protection	• food monitoring • pre-planned provisions for Iodine Thyroid Blocking (ITB)
National Crisis and Disaster Protection Management coordinated by the Federal Ministry of the Interior	• federal co-ordinating institution for crisis management
Federal Alarming Centre in the Federal Ministry of Interior	• National information exchange centre • National Warning Point for international information exchange (ECURIE, IAEA Convention on Early Notification and bilateral agreements)
Nine Austrian Federal Provinces	• implementation of protective actions • responsible for off-site EPR in case of local events

Territory Emergency Planning

As stated previously, due to the General Radiation Protection Act 2020 and the Ordinance on Interventions in Case of Radiological Emergencies 2020 the off-site emergency plans at federal level are regularly updated in accordance with the requirements of the IAEA Safety

Standard GSR Part 7. These off-site emergency plans also cover the possible consequences for Austria caused by emergencies in nuclear facilities outside of Austria.

Testing off-site emergency plans for the Austrian territory

Exercise plans for different types of emergency exercises are part of the updated off-site emergency plans at the federal level. In addition to the participation in exercises at international level (IAEA, European Commission, NEA/OECD), bilateral level (neighbouring countries) and specific exercises for training, the exercise plan requires to conduct national emergency exercises for testing the emergency plans on a regular basis. Based on lessons identified in these exercises BMK is responsible for updating the off-site emergency plans at federal level.

Radiation Warning Systems and Monitoring

The Radiation Protection Act 2020 § 125 obliges the BMK to operate and maintain an automatic Radiation Early Warning System ("Strahlenfrühwarnsystem") which consists of an automatic dose rate monitoring systems and an automated air monitoring system.

The data gathered by the Radiation Early Warning System are exchanged on-line with the European Commission (EURDEP) and corresponding systems in the neighbouring countries of Slovenia, Switzerland, Germany, the Czech Republic, Slovakia and Hungary on the basis of bilateral agreements. Additional measuring data can be obtained by car-borne and air-borne dose rate measurement units by emergency teams of the Federal Ministry of the Interior.

In addition, a laboratory-based monitoring system is operated together with the Austrian Federal Ministry of Social Affairs, Health, Care and Consumer Protection in order to comply with the requirements of rapid recognition and precise determination of radioactive contaminants; it mainly performs the radionuclide-specific monitoring of air, precipitation, surface water bodies, soil, feed- and foodstuffs on the basis of sampling.

In addition BMK is obliged to operate other warning systems such as early notification systems and decision support systems.

F6 Decommissioning – Article 26

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

The decommissioning of the old storage facility for radioactive waste on the NES site in Seibersdorf mentioned in the previous report has been completed in 2017. The second decommissioning project – a former storage building for radioactive waste – has been finished as well in the same year. In addition, work proceeded for the decommissioning of the old hot-cell laboratory, which should be finished within the next 5 years.

The Radiation Protection Act 2020 requires the operator of a radioactive waste management facility or the operator of a research reactor to present a decommissioning concept in the documents for the application of a license. The regulatory authority examines the operation of a facility being in line with the relevant legislation and the conditions and requirements of the relevant licences. Any nuclear facility must be closed if the requirements of the legislation and of the licensing and regulatory acts are not or no longer met taking into account the state-of-the-art of science and technology. For the case that a nuclear facility is going to be decommissioned such a projects always needs a licence. According to the Joint Agreement between the Republic of Austria, NES and the municipality of Seibersdorf, the waste management and interim storage facility is scheduled to be operated until 2045. From that time on, the Austrian Government is responsible for transferring all interim stored waste into an appropriate disposal or long-term storage facility. The radioactive waste management installations and equipment of NES have been subject to regular upgrading and back fitting (the process has to be continued until the end of 2045). For this reason a licence extension is not necessary.

In regard to the TRIGA Mark II Research Reactor there are no short-term or mid-term plans for decommissioning, because of the guaranteed further reactor operation after the Core Conversion in 2012. Nevertheless, the Institute of Atomic and Subatomic Physics has produced a decommissioning concept. Since all 90 fuel elements will be returned to the USA this concept mainly focusses on the disposal of irradiated reactor components and how to decontaminate the site.

Staff and Financial Resources – Article 26 (i)

Such steps shall ensure that qualified staff and adequate financial resources are available.

Adequate financial resources for the decommissioning of existing R&D facilities are guaranteed by a seperate contract between the Republic of Austria and NES. The Austrian Government has taken over responsibility for the costs of decommissioning of nuclear facilities which have been and are operated and owned finally by the Austrian State (research reactors and waste management facility). For this reason no special decommissioning fund has been established.

NES has its own Business Unit “Decommissioning and Decontamination” and therefore qualified staff with a lot of experience in decommissioning. Also employees from the waste management group are educated and have experience in decontamination and decommissioning practices and techniques. Younger personnel is systematically trained and educated to preserve and pass on know-how. NES is provided with adequate financial resources for the recruitment of qualified external staff, if necessary.

In case of the TRIGA MARK II Research Reactor the Vienna University of Technology and the Federal Real Estate Limited Company (“*Bundesimmobiliengesellschaft, BIG*”) as owner of the property and the reactor-building has to finance the future decommission.

Radiation Protection – Article 26 (ii)

Such steps shall ensure that the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied.

The Radiation Protection Act 2020 and the General Radiation Protection Ordinance apply to the decommissioning of nuclear facilities as well. This legislation covers all aspects of Article 26 (ii). As the shut-down, dismantling and decommissioning are major modifications to the operation of a facility for the handling with radioactive material, these activities need a licence according to § 18 of the Radiation Protection Act 2020. This licence for decommissioning lays down complementary obligations as appropriate.

Emergency Preparedness – Article 26 (iii)

Such steps shall ensure that the provisions of Article 25 with respect to emergency preparedness are applied.

The legal requirements concerning emergency preparedness apply independently of whether a facility is in operation or under decommissioning. These requirements cover all aspects of Article 26 (iii).

Record Keeping – Article 26 (iv)

Such steps shall ensure that records of information important to decommissioning are kept.

Records of essential information for decommissioning are kept during the operation. This information allows a more efficient sampling of important materials and components and is very helpful for the determination of the necessary radiation safety measures.

G Safety of Spent Fuel Management – Article 4-10

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.

The Vienna University of Technology signed the supply contract DE-NA0001641 between the Vienna University of Technology, the US Department of Energy and EURATOM-ESA, guaranteeing that all 90 fuel elements currently at the TRIGA Reactor will be accepted for return by the US Department of Energy. This contract was signed in the context of the core conversion in 2012. The fuel at the TRIGA Reactor is under EURATOM and IAEA inspection.

The storage facility at the Institute of Atomic and Subatomic Physics allows either wet or dry storage depending on the fuel element activity. The total capacity for dry storage is 168 and for wet storage 90 TRIGA standard fuel elements in the reactor tank. After the core conversion in 2012, no spent fuel elements are actually stored at the TRIGA Reactor Vienna.

Typically for TRIGA reactors worldwide, spent fuel elements are stored right inside the reactor hall and are therefore under the safety and security management of the reactor building. There are several types of storage facilities available at TRIGA Reactors:

- special designed storage racks inside the reactor tank about 3 meters below the pool water surface
- racks in a pool adjacent to the reactor shielding block filled with water
- fuel storage pits embedded in the reactor hall floor which can be used either for fresh or for spent fuel storage

At the TRIGA reactor Vienna the first and the third mentioned type of storage can be used:

- The storage racks directly in the reactor tank which are suspended along the tank wall about 3 m underwater, which can accommodate up to 90 fuel elements (fresh or spent).
- Six storage-pits in the floor of the reactor hall 3 m deep and about 30 cm in diameter where each one can accommodate up to 28 fuel elements (168 fuel elements in total).

These storage pits can either be filled with water for shielding purposes; in case of fresh fuel elements or low active spent fuel elements these pits are filled with ambient air and vertically shielded by a 25 cm thick lead plug.

H Safety of Radioactive Waste Management

H1 General Safety Requirements – Article 11

> 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.

The protection of individuals, society and the environment against radiological and other hazards is subject to the Austrian legislation on radiation protection and to the legislation on environmental protection (mainly the Environmental Impact Assessment Act and associated ordinances).

Protection of the environment from hazards other than radioactivity is verified by BMK on the basis of the Environmental Impact Assessment Act 2000, which requires an Environmental Impact Assessment (EIA) for major facilities, and on the basis of the Environmental Management Act, which implements the EU eco-management and audit scheme (EMAS).

During the operation, the protection of the workers is assured by requirements and compliance checks of the competent authority, Austrian Labour Inspectorate ("*Arbeitsinspektorat*") and the Occupational Health Services ("*Arbeitsmedizinischen Dienste*").

Civil protection is a competence of the Federal Minister of the Interior, implemented by the Provincial Authorities. Compliance with the legislation on protection of the general public and the environment from non-radiological hazards is verified by the nine Provincial Authorities ("*Bundesländer*").

Criticality and Removal of Heat – Article 11 (i)

In so doing, each Contracting Party shall take the appropriate steps to ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed.

Criticality and removal of residual heat are not an issue for the LILW waste which arises in Austria.

Generation of Radioactive Waste – Article 11 (ii)

In so doing, each Contracting Party shall take the appropriate steps to ensure that the generation of radioactive waste is kept to the minimum practicable.

Minimisation of radioactive waste is a requiremend according to the Radiation Protection Act 2020. The feasibility of radioactive waste minimisation has to be evaluated prior to each handling with radioactive substances. The compliance is verified by the regulatory body in the frame of the licensing procedureand periodic inspections. There has never been any need for a regulatory enforcement action regarding minimisation of radioactive waste.

Interdependencies – Article 11 (iii)

In so doing, each Contracting Party shall take the appropriate steps to take into account interdependencies among the different steps in radioactive waste management.

Interdependencies among the different steps in radioactive waste management is part of the Austrian radioactive waste management policy (see chapter B3).

Optimisation is required by the Austrian Radiation Protection Legislation at all stages of radioactive waste management, thus interdependencies among the different steps are taken into account in practice. NES continuously performs considerations for optimising the treatment, conditioning and storage of the radioactive waste. The licensing procedures as well as the periodic inspections by the regulatory authority take into account interdependencies among the different steps in radioactive waste management.

Protection of Individuals, Society and the Environment – Article 11 (iv)

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

The Austrian Radiation Protection Legislation aims at the protection of individuals, society and the environment from the effects of ionising radiation (see Section E). The applicable dose limits are the same as recommended in the International Basic Safety Standards. In particular, a dose limit for members of the public of 1 mSv effective dose per year and a dose limit for workers of 20 mSv per year are prescribed.

At the NES site there is an intensive program of emission and immission control in operation, which shows the adequate protection of persons and the environment from ionising radiation (e.g. emission measurements of off-gas, waste water, etc.; control of surrounding area e.g. soil, air, water, etc. for radioactivity). The results are checked by an external, independent organisation. Every year NES has to send a report of the environmental monitoring program to BMK, which is part of the inspections.

The protection of the environment against hazards other than radioactivity is the subject of different legal instruments.

Biological, Chemical and other Hazards – Article 11 (v)

> In so doing, each Contracting Party shall take the appropriate steps to take into account the biological, chemical and other hazards that may be associated with radioactive waste management.

Biological, chemical and other hazards are subject to the environmental protection legislation, which also aims at human health protection, especially with requirements concerning air and water quality. An Environmental Impact Assessment is required prior to the construction and operation of large-scale projects. This assessment is reviewed by the appropriate environmental protection authorities before the licence is issued. Hazards other than radiation encountered by workers during handling of radioactive material are

covered by the general legislation on safety at working places, enforced by the supervision by the Austrian Labour Inspectorate ("*Arbeitsinspektorat*").

Impacts on Future Generations – Article 11 (vi)

> In so doing, each Contracting Party shall take the appropriate steps to strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation.

The burdens emanating from present-day nuclear activities shall not be greater than those permitted for the current generation.

Burdens on Future Generations – Article 11 (vii)

> In so doing, each Contracting Party shall take the appropriate steps to aim to avoid imposing undue burdens on future generations.

It is Austria's policy to collect, treat, condition and store all radioactive waste to minimise the burden for future generations. Adequate financial means are being established to support any future disposal strategy.

H2 Existing facilities and past practices – Article 12

Since the beginning of the 1960s, the management of all radioactive waste generated in Austria has been carried out at the Seibersdorf site. This activity has always been based on long-term contracts with the Republic of Austria, so the waste treatment facilities and safety devices always had to comply with the legal requirements and the respective state of the art. While initially radioactive waste was essentially only collected and sealed in packs, more and more facilities for processing and conditioning were set up and put into operation over time.

At the beginning a number of storage halls and other related facilities were built at NES so different categories of waste (liquid burnable, liquid non burnable, solid burnable, solid non burnable, etc.) could be stored in specifically designed buildings. In 1965 a concrete trench (separated in three boxes) and a temporary storage box (composed of concrete

rings) were added for taking up intermediate level waste. An incineration plant as well as a sealed off stainless steel container (for sorting radioactive waste) followed in the late 1970s and a high-force compactor was put into operation in the mid 1990s.

A large investment project started in 2008 and is still continuing (major parts are already completed). Many treatment und storage facilities at NES were modernised or completely new constructed (for example a so called “New Handling Centre” was constructed, where most conditioning equipment was centralized; detailed information see Annex L1).

Consequently all outdated waste treatment facilities have been decommissioned and dismantled. In addition, all disused nuclear research facilities at the entire area of the “historical Seibersdorf research centre” are actually in the process of being decommissioned under contracts with the Republic of Austria and other relevant organisations.

After the installation and comprehensive testing of the new treatment facilities, all existing “historical waste” will be reconditioned accordingly to “state of the art” procedures.

Parallel to the expansion of the processing methods, safety and security precautions and devices have also been increasingly developed and refined (starting with the installation of a water treatment plant in the 1960s). Extensive efforts have been made not only to improve the safe containment of radioactive waste (minimizing the risk of releases or spreading of contamination) but also to prevent unauthorized access to the radioactive material during the last decades.

H3 Siting of proposed facilities – Article 13

Safety, Impact and Information – Article 13 Para 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.

According to the Austrian legislation the siting of radioactive waste management facilities and disposal facilities has to be done according to international standards like the IAEA standards. Therefore, relevant site-related factors likely to affect the safety of such facilities have to be evaluated in the frame of the licensing process. The evaluation of a safety impact of such facilities on individuals, society and the environment would be done in the frame of the mandatory Environmental Impact Assessment.

The Ordinance on Incident Information stipulates the information of the potentially affected public for existing facilities, which today would require an Environmental Impact Assessment to grant permission for their construction.

Furthermore the General Radiation Protection Ordinance commits the licence holder to provide his staff and the public with information on the normal operating conditions of the waste management facility and immediately on events that are relevant from the point of view of radiation protection.

Effects on other Contracting Parties – Article 13 Para 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.

Potential cross border effects are ruled according to international legislation and EC legislation on environmental impact assessments.

H4 Construction, safety assessment and operation – Article 14

Limitation of Radiological Impacts – Article 14 (i)

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

The licensing procedure for the construction of a radioactive waste management facility requires the presentation of a preliminary safety report and a preliminary on-site emergency plan. This preliminary safety report must demonstrate which measures are foreseen to limit possible radiological impacts and discharges or uncontrolled releases that could have a negative impact on human life and health and the environment.

Decommissioning – Article 14 (ii)

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

The Radiation Protection Act 2020 requires a preliminary safety report in the frame of the licensing procedure for the construction. This preliminary safety report should also contain a decommissioning concept for the radioactive waste management facility.

Closure of Disposal Facility – Article 14 (iii)

Each Contracting Party shall take the appropriate steps to ensure that at the design stage, technical provisions for the closure of a disposal facility are prepared.

There are no disposal facilities in operation in Austria now. However, the construction of such a facility would also require a technical provision for the closure of such a facility.

Technologies – Article 14 (iv)

Each Contracting Party shall take the appropriate steps to ensure that the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

The equipment and devices at NES are regularly inspected and, if required or deemed necessary, modernised and back fitted based upon the state-of-the-art.

H5 Assessment of Safety of Facilities – Article 15

Safety Assessment – Article 15 (i)

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

According to the Radiation Protection Act 2020 the operator has to submit a preliminary safety report prior to the authorization of the construction of the facility. This safety report has to outline the radiation risks for the installation itself and its surrounding. Furthermore an Environmental Impact Assessment (EIA) for large-scale projects is required prior to the construction based upon the Environmental Impact Assessment Act (EIA-Act).

Post-Closure Safety Assessment – Article 15 (ii)

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

There is no disposal facility in operation or planned. However, an EIA of radiological and non-radiological hazards is a requirement according to the EIA-Act.

Update of Safety Assessment – Article 15 (iii)

> Each Contracting Party shall take the appropriate steps to ensure that 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).

The licence holder must review the safety report at appropriate intervals, update it if necessary and immediately notify the competent authority any significant changes.

H6 Operation of Facilities – Article 16

Design and Safety Requirements – Article 16 (i)

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

The operation licence for a radioactive waste management facility, is granted based on a safety report demonstrating inter alia the suitability of the site. In the case of radioactive waste management facilities, BMK supervises the construction of the facility and makes sure that the facility is constructed in accordance with the construction licence.

The operation licence is granted if the licencee has successfully demonstrated the compliances with all legal and administrative requirements.

Further radiation protection measures can be prescribed by the licensing authority if there are findings gained during the construction. The operation licence is issued after the test operation in the frame of the construction licence which has demonstrated that the facility fulfils all safety and other requirements.

Defining and Revising Operational Limits and Conditions – Article 16 (ii)

Each Contracting Party shall take the appropriate steps to ensure that operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary.

Preliminary operational limits and conditions for a facility are laid down in the preliminary safety report which is part of the necessary documents for the application of a construction licence. These limits and conditions are checked for their usefulness and suitability in the testing phase of the facility. The experiences gained from the testing phase lead to the final determination of these values and are finally laid down in the operation licence. According to the Radiation Protection Act 2020 any changes of the operational limits and conditions (for example because of operational experiences) require a permission of the competent licensing authority which has the competence to revise these values.

Accordance with Established Procedures – Article 16 (iii)

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

The operation, maintenance and monitoring of a radioactive waste management facility is specified in the operation licence. The corresponding procedures, as described in the facility operation documents, are reviewed by the competent regulatory authority. Their adequacy is a condition for the issuance of the operation licence.

Engineering and Technical Support – Article 16 (iv)

Each Contracting Party shall take the appropriate steps to ensure that engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility.

According to the Radiation Protection Act 2020, the fulfilment of requirements regarding the staff and the organisation is a prerequisite for the granting of the operation licence of a radioactive waste management facility. The requirements concerning staff and organisation are outlined in the Radiation Protection Ordinance.

Characterisation and Segregation of Radioactive Waste – Article 16 (v)

Each Contracting Party shall take the appropriate steps to ensure that procedures for characterisation and segregation of radioactive waste are applied.

NES defines the acceptance criteria for the delivery of radioactive waste from the producers. The producer of radioactive waste is obliged to segregate and label the waste according to categories like liquid-combustible, liquid-non-combustible, solid-combustible, solid-non-combustible, biogenous waste or disused sealed radioactive sources. The polluters must also provide information on the radionuclides and their activities.

The treatment of radioactive waste is done according to clearly defined procedures at NES.

Reporting of Incidents – Article 16 (vi)

Each Contracting Party shall take the appropriate steps to ensure that incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body.

The operator of a radioactive waste management facility has to report immediately the following incidents to the competent authority according to § 74 of the General Radiation Protection Ordinance:

- a release of radioactive substances into the environment that goes beyond the approved discharge
- a radiation protection relevant contamination or release of radioactive substances within the facility
- malfunctions, damage or failures of safety-relevant systems or system parts
- damage or leakage in safety-relevant pipelines or containers
- safety-relevant incidents during the treatment of radioactive waste
- safety-relevant external influences such as earthquakes or floods

- safety-relevant plant-internal incidents such as fire or plant-internal flooding
- contamination of persons or incorporations who have required medical attention.

Collection and Analysis of Operating Experience – Article 16 (vii)

Each Contracting Party shall take the appropriate steps to ensure that programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate.

The licence holder must keep records that are decisive for assessing the safety of the facility from the point of view of radiation protection. The records must also contain the information required for the reconstruction of the causes of events listed in the paragraph above. The licence holder can be obliged by the authority to fulfil additional prescriptions.

Decommissioning Plans and Closure of Disposal Facility – Article 16 (viii)-(ix)

Each Contracting Party shall take the appropriate steps to ensure

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

(ix) that 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.

A decommissioning concept is an integrated part of the licence for the operation of a radioactive waste management facility according to the Austrian legislation. Detailed specifications for such a concept are prescribed in the General Radiation Protection Ordinance.

The licence holder must update the decommissioning concept if necessary and, in the event of significant changes, submit it to the competent authority without delay.

At the moment there are no plans for the closure of a disposal facility since there are no facilities in operation.

H7 Institutional measures after closure – Article 17

Keeping Records – Article 17 (i)

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility records of the location, design and inventory of that facility required by the regulatory body are preserved.

In Austria no disposal facility is in operation. The Austrian legislation does not yet contain specific legal requirements for a closure of such a disposal facility.

Institutional Controls – Article 17 (ii)

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility active or passive institutional controls such as monitoring or access restrictions are carried out, if required.

Specific regulations of the institutional controls after closure have not been decided yet since there are no disposal facilities in operation. The Radiation Protection Act 2020 allocates the corresponding decisions to the federal government.

Intervention Measures – Article 17 (iii)

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

Austria has implemented a national monitoring programme of the radioactivity in the environment. This monitoring is performed by the BMK. Intervention measures to be taken in the case of increased radiation in the environmental are established by the radiation protection legislation. The responsibility for such potential intervention measures lies with the Federal State.

I Transboundary Movement – Article 27

I1 General Requirements - Article 27 Para 1

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

The import, export and transit of radioactive waste (including spent fuel declared as waste) are subject to the Ordinance on the Shipment of Radioactive Waste into, out of or through the Austrian federal territory.

Transportation of fissionable material on Austrian territory is generally prohibited unless under an international agreement. Fissionable material for the purpose of peaceful use if not for the production of nuclear power is allowed to be transported. The transport of fissionable material arising from the nuclear energy production is also prohibited if the purpose is final disposal.

Authorisation by State of Destination – Article 27 Para 1 (i)

> In so doing, 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.

According to the Ordinance on the Shipment of Radioactive Waste an approval can be granted if following requirements are fulfilled:

- no legal reason for exclusion exists (see I2)
- no indirect or imminent danger for the human life or health including human descendants from ionising radiation

- the State of destination and the States of transit (if any) have agreed to the shipment for the stated purposes within the framework of an international agreement or within the applicable European Community or EURATOM Law
- the exporter has entered into a binding written agreement with the importer of the radioactive waste which stipulates that the exporter shall take back the waste if the shipment cannot be completed according to the relevant legal provisions or the conditions attached to the approval

Movements through States of Transit – Article 27 Para 1 (ii)

In so doing, transboundary movement through states of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized.

IAEA's Regulations for the Safe Transport of Radioactive Material (SSR-6 former TS-R-1) are incorporated in the UN Recommendations on the Transport of Dangerous Goods. They are put into legally binding force by following modal conventions to which Austria is a party:

- the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)
- the Regulation Concerning the International Carriage of Dangerous Goods by Rail (RID), Annex C to the Convention Concerning the International Carriage by Rail (COTIF)
- the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)
- the SOLAS Convention with the International Maritime Dangerous Goods (IMDG) Code
- the Convention on International Civil Aviation with its Annex 18 and the ICAO-Technical Instructions for the Safe Transport of Dangerous Goods by Air.

All these regulations are applicable for national and international transport of dangerous goods in Austria

- either by themselves
- or by reference
  - in the Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 or
  - in the Austrian Act on the Transport of Dangerous Goods (GGBG).

This Act also establishes the institutional framework for the administration and enforcement of the said regulations.

Requirements for State of Destination – Article 27 Para 1 (iii)

> In so doing, 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.

The Radiation Protection legislation prohibits the takeover of radioactive waste at NES not arising in Austria. Therefore an import of radioactive waste from a foreign country is not possible since there are no other radioactive waste management facilities in operation in Austria.

Meeting the Requirements for State of Destination – Article 27 Para 1 (iv)

> In so doing, 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.

According to § 9 and § 17 of the Ordinance on the Shipment of Radioactive Waste, an authorization is required for the transboundary movement of radioactive waste from Austria to another state. The conditions are explained in detail therein, as can be seen above in “Article 27 Para 1 (i)”, which ensures that the respective requirements of the Convention are fulfilled.

Re-entry in case of non-conformity – Article 27 Para 1 (v)

> In so doing, a Contracting Party which is a State of origin shall take the appropriate steps to permit a 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.

In case of a shipment of radioactive waste from Austria to a destination out of the Austrian territory the Ordinance on the Shipment of Radioactive Waste explicitly requires a written and legally binding agreement between the holder and the consignee obliging the holder to take back the radioactive waste in case the shipment procedure cannot be accomplished or the conditions attached to the approval of the shipment are not fulfilled.

The competent national authorities which approved the transit for a shipment may not refuse the reshipment if the initial shipment was approved for treatment or reprocessing purposes and if the reshipment concerns radioactive waste or other products equivalent to the original material after treatment or reprocessing when all relevant legislation is respected. In case of a shipment failure, the national authorities must allow the repatriation of the radioactive waste, if a transboundary movement cannot be completed in conformity with the relevant legislation and the reshipment is undertaken in a safe manner on the same conditions and with the same specifications as stated in the initial application.

I2 Shipments south of Latitude 60 – Article 27 Para 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.

According to § 6 of the of the Ordinance on the Shipment of Radioactive Waste the competent authorities have to refuse a licence for shipments

- to a destination south of latitude 60 degrees south or
- to a State Party to the Cotonou ACP-EC Agreement which is not a member of the European Community, taking into account reshipments or
- into a third country, which does not have the technical, legal or administrative resources to safely manage the radioactive waste in the opinion of the competent authorities of the country of origin (provisions and criteria for reshipment must be taken into account).

J Disused Sealed Sources – Article 28

J1 Possession, Remanufacturing and Disposal – Article 28 Para 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.

According to the Radiation Protection Act 2020 the possession, (re-) manufacturing as well as temporary storage and disposal are subject to the authorisation procedure. In order to minimize radioactive waste, the preferred management option concerning disused sealed sources is the return to the manufacturer. In cases of disused sealed sources where this is not possible, recycling (e.g.: reuse by a third party) is encouraged.

According to § 141 of the Radiation Protection Act 2020, the requirements of Article 11 (general safety requirements) are fully implemented.

J2 Re-entry into Territory – Article 28 Para 2

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

The re-entry of disused sealed sources into Austrian territory is allowed. Practices involving activities above the exemption values need prior licensing.

The requirements for shipments of radioactive sources are laid down in the EU Council Regulation No 1493/93/EURATOM of 8th June 1993 on the shipment of radioactive substances between Member States, which is directly applicable for the import and export of radioactive sources. The Radiation Protection Act 2020 regulates shipments of radioactive sources between Austria and third countries with concurring requirements.

K Activities to Improve Safety

As shown in the present report, the safety of radioactive waste management in Austria complies with the obligations of the Convention. However, Austria strives for continuing improvements of safety (especially in accordance to the Challenges and Suggestions identified at the Sixth Review Meeting – "Rapporteur´s Written Report").

Challange 1: Finalisation of the National Program for radioactive waste management

- According to the Radioactive Waste Management Directive (Council Directive 2011/70/EURATOM for the responsible and safe management of spent fuel and radioactive waste) Austria has established a National Program for Radioactive Waste Management to describe all steps of spent fuel and radioactive waste management from generation to disposal. This program was subject of a Strategic Environmental Assessment according to § 142 of the Radiation Protection Act 2020. In September 2018 the Austrian Federal Government approved this program.

Challange 2: Implementation of the National Program, including the decision on the plan for disposal

Challange 3: Continue modernisation of waste treatment facilities in Seibersdorf

- Austria implements the scope and plans of its National Program for Radioactive Waste:
  - On the one hand the facilities for predisposal management of the radioactive waste at NES are continuously improved to meet highest international standards. Many improvements, optimisations and modernisations were carried out in the last years. Today the techniques and procedures are almost at the state of the art. The concept for future radioactive waste management is near completition. Some related projects (new handling center for radioactive waste, new storage concept, renewal of incinerator plant) have already been completed or are near completion. The modernisation of the predisposal management facilities at NES will be finished in 2021 (see also chapter L).
  - A decision on the location and type of the required disposal facility has not yet been taken in Austria. In 2020 the Austrian Government will establish an

interdisciplinary working group enhancing and implementing the National Programm. This “National Radioactive Waste Management Committee” will advise the government on the expected future amount of waste for disposal, on technical disposal options and on a strategy for transparency and participation of the public. Members of the Committee will represent ministries and federal provinces, independent experts, stakeholders and the civil society. The first meeting is planned for the beginning of 2021.

Challange 4: Continue with re-conditioning of old conditioned waste at NES

- A “reconditioning project” of radioactive waste conditioned in the past is still ongoing: All drums with conditioned radioactive waste are going to be moved individually from the interim storage facilities and inspected in a special handling facility. The content is removed and put into new 200-litre-drums, which are of flange-type and equipped with a liner made of reinforced plastic on their interior. After drying in a special drum drier and precise documentation, the drums are relocated into a newly constructed interimstorage facility (next to the old building), where they are arranged horizontally. The content of very old drums, which to some extend lack a documentation, is analysed, reconditioned according to the state of the art and filled into new drums. The reconditioning is expected to reduce the existing waste volume, stored at NES.

- In 2020 Austria transposed the European Basic Safety Standards (Council Directive 2013/59/EURATOM) fully into national legislation. This transposition required the adoption of a Radiation Protection Act 2020, replacing the existing act, and the full revision of corresponding ordinances.
- In 2018 Austria conducted the first IRRS mission involving several competent authorities on the federal level. The corresponding action plan is still under development, implementing the recommendations and suggestions of the mission.
- Austria will host an ARTEMIS mission in the second half of 2022.

L Annexes

L1 Nuclear Engineering Seibersdorf GmbH (NES)

The following chapters describe in short the existing radioactive waste management facilities of the Austrian centralized pre-disposal and interim storage facility NES.

Materials Reception Building

The Materials Reception Building is arranged next to the Waste Water Treatment Facility. The whole material transfer to and from the NES waste management plant (radiation area) is carried out via this building. Hence one part of the building is foreseen as a large air-lock for trucks. The second part of the Materials Reception building is used for pre-classification und buffering of incoming waste.

Segregation

Pre-sorting of radioactive waste is required from the waste producers. For specific tasks, such as dismantling of larger equipment, a special room ("sorting box") equipped with a negative pressure ventilation system is used. This sorting-box was refurbished to improve material flow and radiation protection. Depending on the hazards involved, work is carried out in supplied-air suits or full-face masks.

Waste water treatment facility

In this facility, waste water from the Seibersdorf site is treated. The four waste water sources include incinerator operations, operation of other waste treatment facilities and laboratories with radioactive material, all other laboratories on site (theoretically inactive waste water), and the IAEA Nuclear Materials Lab (NML) delivering potentially α-contaminated waste water.

Figure 2 Waste water treatment plant Seibersdorf (scheme), © NES

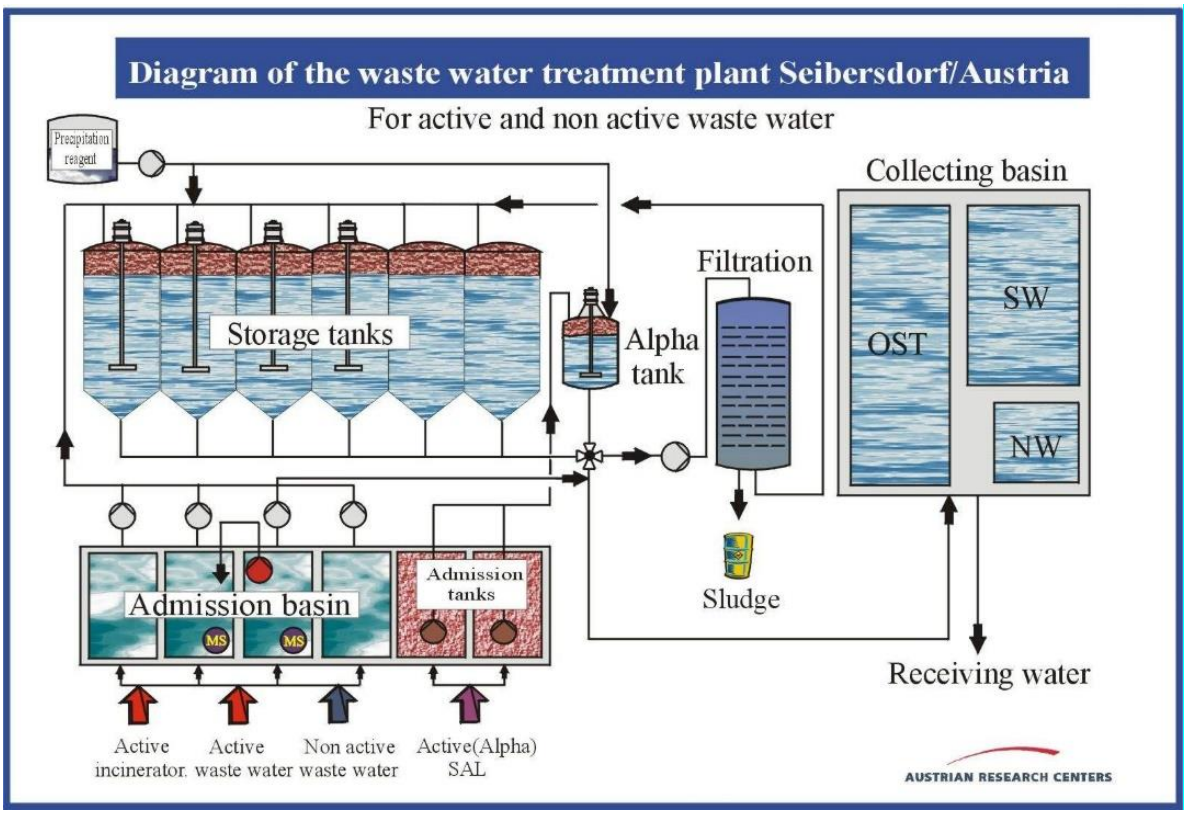


Figure 2 shows a schematic depiction of the facility. As a first step, waste water is delivered via direct pipeline connections from the point of origin into separate admission basins. Then Measurements are performed to determine the activity of the waste water. If below the regulatory limits, the water is transferred directly into the collecting basin and, after repeated measurements, discharged into the environment. In the opposite case, the water is pumped into the storage tanks and after that decontaminated by filtration using diaphragm techniques (microfiltration in cross flow mode). This process is able to remove the radionuclides from the waste water omitting the addition of chemical reagents and filter aid, thus a large reduction of waste volume is achieved. The microfiltration process yields a concentrate, which is further treated by flocculation and sedimentation, the resulting sludge is dried and conditioned in the high force compactor. The liquid is pumped back into the storage tanks, rechecked for activity, and transferred into the collecting basin.

As alternative to the microfiltration process described above a former used precipitation/filtration process can be applied. Thereby the contaminated waste water is also pumped to the storage tanks, some equipped with stirrers, where a precipitation is performed by addition of a suitable reagent like $[Fe(CN)_6]^{4-}$ for Cs^+ precipitation. The active precipitate is separated from the liquid in a special "Filtrox®" filtration unit (resulting

sludge is further conditioned as described above). The liquid is pumped back into the storage tanks, rechecked for activity, and transferred into the collecting basin. Occasionally, a second precipitation may be called for to comply with the regulatory limits.

High-force compactor

Non burnable solid radioactive waste can be treated using the high-force compactor[3]. In the year 2016 a new 1500 t compactor in vertical design, which is fully remote controlled, started operation.

The high-force compactor is situated in it's own room with material- and air-locks. The operator remote controls all movement from a control desk outside the room. Only for service and intervention personnel can access the room in forced air ventilated hazmat suits.

The produced pellets are automatically loaded into 200-litre-drums using a double cover airlock system.

Depending on the waste characteristics, a volume reduction factor of 2 to 10 can be reached.

[3] Examples of waste being supercompacted are: Demolition waste from decommissioning projects like contaminated soil and rubble, laboratory waste like glass or secondary waste like air filters or dried sludges from the water treatment plant.

Figure 3 New super compactor with parts of handling system, © NES

Cementation equipment

Cementation (grouting) is a conditioning and immobilisation method which was commonly used at NES but has decreasing importance for the last years. Homogeneous cementation is carried out in-drum by a dedicated in-drum mixer (waste with cement and water).

Interim storage

Conditioned radioactive waste is stored within four dry engineered construction storage facilities (storage facilities no. 12, 12A, 13 and 14).

In the “old” storage buildings LH12/12A the drums are tightly packed (see Figure 4), in the new storage buildings LH13, LH14 and in future also LH15 the drums are stored horizontal on special designed racks (see Figure 5). This configuration enables the inspection of each drum at all times. The inspection scheme for drums in this new configuration is as follows: All drums initially entering the interim storage facility are inspected. After this first

inspection there are visual inspections going on every year in such a way that each individual drum is inspected every 5 years. The inspections include a visual control and wipe tests for additional contamination control.

The additional and last facility LH15 has been erected in 2018/19. All new buildings are equipped with a thermal insulation and a heating- and dehumidification-system in order to reduce the risk of corrosion for the steel drums.

All waste drums will be stored in a new configuration. After removal of all drums from LH12/12A this facility will be decommissioned.

As of end of 2019 11 826 waste packages (mainly 200-litre-drums) were stored in the interim storage (the capacity of LH13, 14 and 15 together will be approximately 18 000 drums in the future).

Figure 4 Conditioned waste in interim storage facility 12A, © NES

Figure 5 Conditioned waste in interim storage facility 13, © NES

Incinerator

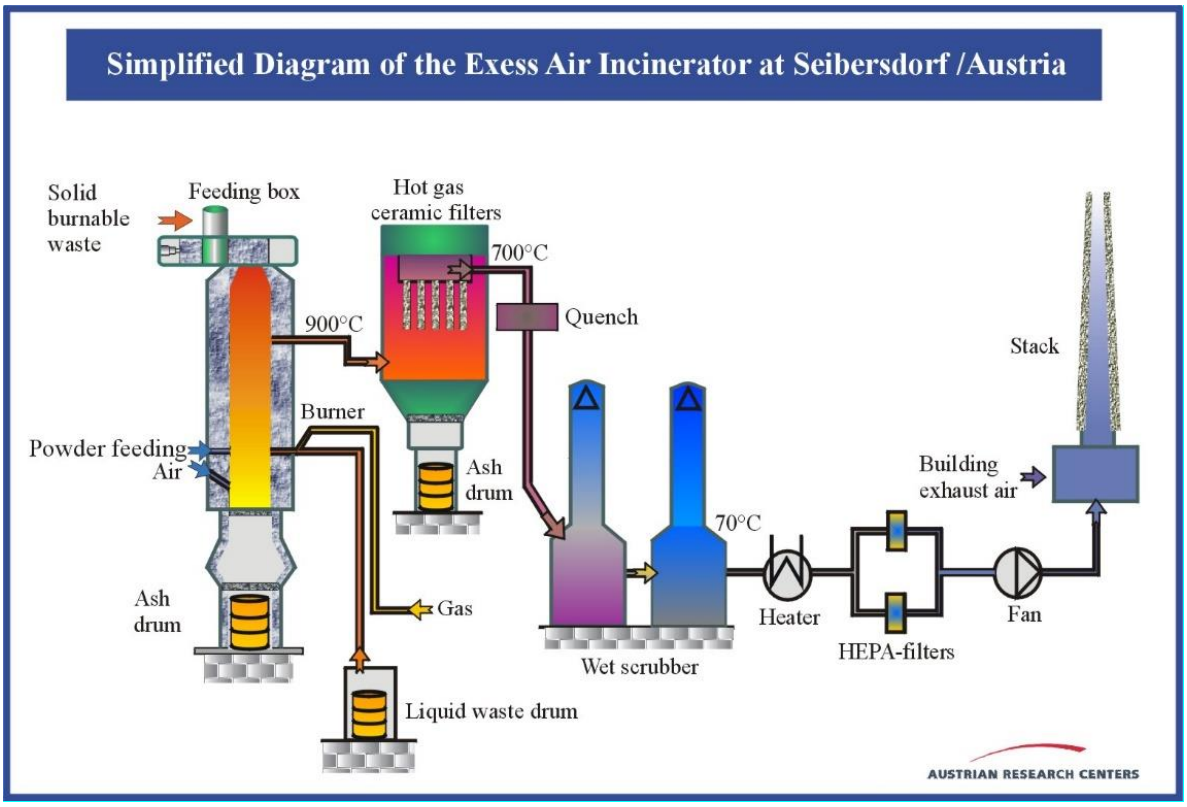
The shaft incinerator of the "*Karlsruhe*" type is an excess air unit having a capacity of about 40 kg per hour and a combustion volume of 1 m diameter and 5 m height. The off-gas cleaning system consists of a set of ceramic hot gas filters, quench, two stage wet scrubber and HEPA-Filters.

Over the years a number of modifications to the original design have been carried out in order to improve safety, to keep up the technical standard and to meet requirements of changing regulations. Especially the off-gas cleaning system has been changed considerably compared to the original design.

In addition, modifications to the shaft have been carried out, where for example additional openings were introduced in order to facilitate effectively the incineration of powdery material.

In 2007 a modern, online-monitoring-system for the exhaust-air of the incinerator-building was installed. The system consists of an isokinetic sampling-system installed in the stack, an aerosol-monitor as well as separate monitors for tritium and iodine.

Figure 6 Simplified Diagram of the Excess Air Incinerator, © NES



Technical data of the incinerator:

- Excess air incinerator
- Shaft type, single chamber
- Combustion chamber: 1 m diameter, 5 m high
- Combustion temperature: 1000 °C
- Capacity: ~40 kg/h solid burnable waste (calorific value: average 21×10^6 J/kg = 5000 kcal/kg)
- Negative pressure in the combustion chamber: 10^3 Pascal = 10 mbar
- Feeding from top batch wise (2-3kg) through airlock, liquids through burner
- Hot gas filter, in brick-lined filter box, Silicon-carbide candles, mean porosity : 20 µm
- Quench, spray cooler with nozzles, decreases off-gas temperature from 700 °C to 70 °C
- Two stage scrubber (one trickle flow, one spray) using caustic soda solution to pH 8.1
- Heater, raises off-gas temperature to ~100 °C
- HEPA filters
- Off-gas draft fan, radial blower, regulated by negative pressure of combustion chamber
- Mixing chamber
- Stack, 35 m high

Operation:
Depending on the amount of radioactive waste to be combusted the incinerator is operated in campaigns (in average 3 months a year). It is operated in two shifts a day, i.e. from 6h00 till 22h00 5 days a week, with two operators in one shift.

The treatment of the wastes results in a volume reduction of about 50:1 comparing raw material to ashes. But operating such a facility creates secondary waste, changing the picture of volume-reduction significantly. Apart from operational waste as hot gas- and HEPA-filters, contaminated parts from maintenance and repairs, a number of replacements have to be included.

Activity throughput:
The activity of institutional waste is very low. Due to its characteristics, routine measurements and reported activity values of the raw waste are very inaccurate. So, the activity of waste fed into the incinerator is badly known and cross contamination within the incinerator unit causes an additional problem, i.e. the surfaces of the plant exposed to the off-gas adsorbs radioactive particles from the passing off-gas and simultaneously releases such particles into it. These factors together indicate that activity balancing is very difficult.

Nevertheless, activity balancing is possible for some radionuclides on the basis of analyses of ash, wastewater from the scrubbers and off-gas samples.

It was found that ^{137}Cs and ^{241}Am are contained in the ashes to 80 %, and 20 % are carried to the wastewater, where they are removed by the routinely run treatment process (co-precipitation and filtration). Radioisotopes of Iodine are removed to nearly 100 % in the scrubber. None of these nuclides are detected in the off gases.

Tritium is found to 80 % in the wastewater, the rest in the off gases. ^{14}C is emitted with the off gases.

Drum drying system
Before placing the drums to the interim storage, most conditioned drums of NES are dried to ensure the long term chemical stability of the content and to minimize the risk of internal corrosion in the drum.

For this purpose a drum-drying-system is in operation; main technical data are as follows:

- capacity: Simultaneous drying of up to 32 pcs. 200-litre-drums (drying of containers with other geometry is also possible)
- drying temperature: Adjustable up to a maximum of 140 °C
- fully automatic operation (except loading-/unloading-procedures controlled/performed manually)
- drying performed at slight under pressure (kept for radiological reasons)
- electric heating

Figure 7 Drum drying system, © NES

Measuring facility

Low-level measurement facility

To minimise waste, NES carries out clearance measurements of slightly radioactive materials like concrete and soil by using a modern, automatic measurement facility. Thus, low-level materials can be disposed of as inactive waste as long as the activities measured are below the legally stipulated clearance thresholds.

Figure 8 Low-level measurement facility, © NES

Waste assay system

Due to the fact that gamma-emitting raw and conditioned radioactive waste shows a high variability both in terms of nuclide composition and physical make-up (raw waste versus the different forms of conditioned waste) and form (i.e. different geometries and drums) a flexible approach is needed together with an assay system that is configurable and uses various assay methods.

The assay system on site therefore supports various methods and can for instance act as an Integral Gamma Scanner (IGS) for homogenous matrix types using a single far-field

emission spectra for the assay, a Segmented Gamma Scanner (SGS) for data acquisition for more heterogeneous matrix types using a number of near-field emission spectra or as a Tomographic Gamma Scanner (TGS) for three-dimensional transmission and emission images respectively.

Measurement-time constraints also weigh in on which assay methods are used. To allow for a higher throughput the system also supports automated supervisor functions allowing the drums staged to be assayed automatically according to a preloaded table.

The assay system consists of the following components:

- Collimated, coaxial p-type high purity germanium (HPGe) detector mounted on a vertical detector lift assembly
- Digital Signal Processor (DSP), a reference pulser as well as an acquisition interface board providing a full featured Multi-Channel Analyser
- A highly collimated ^{60}Co transmission source (9.25 GBq nominal activity) with tungsten shutter and lead storage shield atop a vertical lift assembly
- Drum rotator, translation assembly and conveyor system for automated measurement of up to six 200-litre-drums

Figure 9 Waste Assay System in the measuring facility at Seibersdorf, © NES

Documentation

All relevant data from the information of the customers across all levels of processing and conditioning steps to interim storage are stored in a comprehensive database system. This system, called "*DOKURAD*", has been completely newly designed, programmed and optimised in the recent years.

Part of the optimisation of this in-house database solution is a process management part that is linked to a QR-Code based system for the material flow of all RAW and containers within the premises of the waste management site at NES. This system was developed in 2019 and will finish being implemented in 2020.

New concept for future radioactive waste-management at NES

In compliance with the Joint Agreement between the Republic of Austria, NES and the municipality of Seibersdorf, long-term interim storage ("transfer-storage") of radioactive

waste has to be assured until 2045. This extension of the storage time for the existing (and future) radioactive waste required significant investments in new buildings and machinery and additional measures for the stored containers with radioactive waste (additional- and re-conditioning) at NES. In the following section the main items of this renewal concept are briefly described (main buildings and machinery associated to the new concept are already erected/installed and in operation).

New Manipulation Centre including equipment

The existing Workshop Building was extended to a New Handling Centre (NHC). In this new building NES concentrated most of its conditioning facilities for radioactive waste. The NHC also provides for radiation safety according state of the art and for an optimised flow of material.

In the new building the following equipment was installed:

- two Caissons ("sorting/manipulation boxes") made of stainless steel: One caisson is mainly used for the additional- and re-conditioning works (as described thereinafter), the second caisson will mainly be used for conditioning and decontamination of bulky materials. Operations within the Caissons are done in forced air ventilated hazmat suits.
- a new vertical High-Force-Compactor (1500 t)
- a new Hot Cell (with underground storage) replacing existing Hot cells (will be decommissioned)
- a centre for manipulation of radiation sources
- a drum drying system
- cementation equipment
- laboratories (Measurement and quality assurance)

Storage concept

A new storage concept for the 200-litre-drums was already implemented in storage facilities no.13, 14 and 15: All drums are stored horizontally in a way that will enable individual drum inspection at all time.

The existing storage facilities no.12 and 12A will be decommissioned after all drums are transferred to the new storage buildings.

Storing the drums following the new concept (with possibility for individual inspection of each drum) will require more space compared to former storing-practise. The future storage capacity at Nuclear Engineering Seibersdorf will approximately be 18000 drums.

Reconstruction of existing Incineration plant

This facility will be refurbished in the years 2017–2021 to further reduce the risk of contamination-carryover to achieve an improved flow of material and works and to improve (non-radiologic) off-gas characteristics.

Specifically to improve the flow of materials (waste to be incinerated, bottom and fly ash) the respective components (waste feeding and ash removal system) have been modified to reduce the risk for the operators. Most operations, which were executed manually before, will be performed by highly automated mechanical devices. For the remaining operations glove box and double cover air-lock techniques will be employed. To improve non-radiological off-gas characteristics, an afterburner and an activated carbon in a fixed bed filter were installed.

Additional- and Re-Conditioning

The interim-storage time (up to 2045) requires measures to be taken for the conditioned waste in stock from before the new storage concept. All these drums will be taken from the storage facility and inspected. The content will be removed and put into new 200-litre drums, which will be flange-type and equipped with a liner made of reinforced plastic on their interior. After drying and precise documentation for each container, the drums will be put back to the storage facilities, where they will be arranged horizontally (each drum can be inspected individually over the whole time of storing).

Approximately 10000 (mostly 200 litre) drums will be treated within the project that consists of three phases:

Phase 1:

This phase consists of the re-conditioning of pellet-drums (repackaging, drying, characterization). This phase has already been completed and about 1500 drums re-conditioned.

Phase 2:

Reconditioning of homogenous cemented drums. Historically sludges and ashes have been cemented in 200 litre drums. These drums will be dismantled, milled and repackaged. During these processes characterisation is being done as well.

The dismantling and milling is done in the Caissons using remote-controlled machinery (operated out of the Caisson).

This phase is in progress.

Phase 3:

This phase consists of re-conditioning inhomogenously cemented drums. These consist of historic waste that was mostly in 100 litre drums that have been cemented into 200 litre drums. These drums are dismantled and are having their concrete lining cut using the same remote-controlled machinery as described for phase 2. Afterwards the inactive concrete is mortised away and the RAW conditioned again and characterised.

Conditioning in this step means that combustible waste is segregated and set to the incineration plant, non-combustible waste goes to the super-compactor and will subsequently be dried.

Especially phases 2 and 3 of the re-conditioning project will minimize the waste as incineration, super-compaction but also metal melting and clearance are being considered. So far (end of 2019) 2500 drums (phase 1 and 2) have been re-conditioned.

Safety Measures:

The erection of a new Central Access Building – which is already in operation – allowed a clear separation between active and inactive areas minimizing the risk of contamination-carryover and additionally connected the Incineration Plant and the Waste Water Treatment Facility. It acts – similar to the Materials Reception Building for material transfer – as a central air lock for all personnel entering or leaving the premises of NES waste management plant (radiation area).

In addition, an improved perimeter security system for the fence around the premises of NES (radiation area) was installed to ensure physical- and/or video-detection of potential intruders.

L1.1 References to international Regulations and Directives

Council Directive 2013/59/EURATOM of 5th December 2013 **laying down basic safety standards for the protection against the dangers from exposure to ionising radiation**, CELEX-Number: 32013L0059.

Council Directive 2011/70/EURATOM of 19th July 2011 **establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste**, Official Journal L of 2nd of August 2011 no. 199/48.

Council Directive 2006/117/EURATOM of 20th November 2006 on the **supervision and control of shipments** of radioactive waste and spent fuel, Official Journal L of 5th December 2006 no. 337.

Council Decision 87/600/EURATOM of 14th December 1987 on **Community arrangements for the early exchange of information in the event of a radiological emergency**, Official Journal L no. 371/79 of 30th December 1987.

Council Regulation (EURATOM) No. 1493/93 of 8th June 1993 on **shipments of radioactive substances between Member States**, Official Journal L of 19th June 1993 no. 148/4.

Commission Regulation 2012/965/EU of 5th October 2012 **laying down technical requirements and administrative procedures related to air operations pursuant to Regulation 2008/216/EC of the European Parliament and of the Council,** Official Journal L of 25th October 2012 no. 296/1.

Convention on Early Notification of a Nuclear Accident, INFCIRC/335, of 18th November 1986.

Convention concerning International Carriage by Rail (COTIF), Bern, 9th May 1980, ratified by Austria on 8th March 1983, announced in Federal Law Gazette no. 225/1985 of 11th June 1985.

International Convention for the Safety of Life at Sea (SOLAS), London, 1st November 1974, ratified by Austria on 27th May 1988, announced in Federal Law Gazette no. 435/1988 of 5th August 1988.

Convention on International Civil Aviation, Chicago, 7th December 1944, ratified by Austria on 27th August 1948, announced in Federal Law Gazette no. 97/1949 of 6th May 1949.

European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), Geneva, 30th September 1957, ratified by Austria on 11th August 1973, announced in Federal Law Gazette no. 522/1973 of 7th November 1973.

European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN), Geneva, 26th May 2000, ratified by Austria on 9th November 2004, announced in Federal Law Gazette III no. 67/2008 of 28th May 2008.

L1.2 References to national Laws and Ordinances

Federal Constitutional Act for a Nonnuclear Austria („*Bundesverfassungsgesetz für ein Atomfreies Österreich*"), Federal Law Gazette I no. 149/1999 of 13th August 1999.

Radiation Protection Act 2020 („*Strahlenschutzgesetz 2020*"), Federal Law Gazette no. 50/2020 of 1st August 2020.

Administrative Penal Act 1991 *(„Verwaltungsstrafgesetz 1991 - VStG"*), Federal Law Gazette no. 52/1991 of 31st January 1991, last amended on 20th May 2019.

General Administrative Procedures Act 1991 („*Allgemeines Verwaltungsverfahrensgesetz 1991 - AVG*"), Federal Law Gazette no. 51/1991 of 31st January 1991, last amended on 17th May 2019.

Environmental Impact Assessment Act („Umweltverträglichkeitsprüfungsgesetz 2000"), Federal Law Gazette no. 697/1993.

Administrative Enforcement Act 1991 *(„Verwaltungsvollzugsgesetz 1991"*), Federal Law Gazette no. 53/1991 of 31st January 1991, last amended on 11th November 2014.

Act on the Transportation of Dangerous Goods („*Bundesgesetz über die Beförderung gefährlicher Güter. - Gefahrgutbeförderungsgesetz*"), Federal Law Gazette I no. 145/1998 of 20th August 1988, last amended on 13th July 2018.

Medical Radiation Protection Ordinance („*Medizinische Strahlenschutzverordnung - MedStrSchV*"), Federal Law Gazette II no. 375/2017 of 6th February 2018, last amended on 10th August 2020.

General Radiation Protection Ordinance („*Allgemeine Strahlenschutzverordnung*"), Federal Law Gazette II no. 339/2020 of 29th July 2020.

Ordinance on Interventions in Case of Radiological Emergencies or in Case of Lasting Exposure 2020 („*Interventionsverordnung*"), Federal Gazette II no. 334/2020 of 30th July 2020.

Ordinance on Natural Radiation Sources („*Natürliche Strahlenquellen-Verordnung*"), Federal Law Gazette II no. 2/2008 of 7th January 2008.

Ordinance on the Shipment of Radioactive Waste („*Radioaktive Abfälle-Verbringungsverordnung 2009*"), Federal Law Gazette II no. 47/2009 of 19th February 2009, last amended on 22nd July 2020.

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Abbrevations

ACP-EC	Cotonou ACP-EC Agreement which is not a member of the European Community, partnership agreement
ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road
ALARA	As low as reasonably achievable (ALARA) principle
ARTEMIS	Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation
BMBWF	Federal Ministry of Education, Science and Research
BMI	Federal Ministry of the Interior
BMK	Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology
Bq	Becquerel
COTIF	Convention Concerning the International Carriage by Rail
DoE	US Department of Engergy
EC	European Commission
ECURIE	European community Urgent Radiological Information Exchange system
EIA	Environmental Impact Assessment
EMAS	Eco-Management and Audit Scheme
EPR	emergency preparedness
EU	Eurpean Union
EURATOM	European Atomic Energy Community
FAC	Federal Alarming Centre (FAC) in the Federal Ministry of Interior (BMI)
GGBG	Austrian Act on the Transport of Dangerous Goods
HEPA	High-Efficiency Particulate Air/Arrestance
HLW	High-level radioactive waste
IAEA	International Atomic Energy Agency
ICRP	Interantional Commission on Radiation Protection
INFCIRC	International Atomic Energy Agency Information Circular

IRRS	Integrated Regulatory Review Service (IRRS)
LILW-LL	long lived low and intermediate level waste
LILW-SL	short lived low and intermediate level waste
NES	Nuclear Engineering Seibersdorf GmbH
NML	IAEA Nuclear Materials Lab
NORM	Naturally Occurring Radioactive Material
NPP	Nuclear Power Plant
RID	International Carriage of Dangerous Goods by Rail
SOLAS	SOLAS (Safety for Life at Sea) Convention with the International Maritime Dangerous Goods (IMDG) Code
TU Wien	Vienna University of Technology
TRIGA	Research reactor in Vienna
VSLW	Very short lived waste

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