Republic of Austria

Eighth NATIONAL REPORT

under the

CONVENTION ON NUCLEAR SAFETY - AUSTRIA

Vienna, July 2019

Content

A Introduction

The form of the Austrian National Report for the 8th Review Meeting under the CNS (2020) follows the structure given in guideline INFCIRC/572/Rev. 6. Its content has been updated, in particular taking into account all recent changes of the legislative and regulatory framework and upgrades of the TRIGA research reactor.

Austria would like to recall, that it reports, since the first review cycle under the Convention on Nuclear Safety, on its research reactor on a voluntary basis.

This report also intends to reflect the spirit of the Vienna Declaration on Nuclear Safety to continuously improve nuclear safety concerning its research reactor. According to the President's letter of 13 December 2018, this information can be found under reporting of the pertinent articles of the Convention.

B Summary

Austria has never operated a nuclear power plant and according to the Constitutional Law on a Nuclear-free Austria [BGBl. I No. 149/1999: Bundesverfassungsgesetz für ein atomfreies Österreich] there is a legal prohibition to do so in the future. Austria's high interest in the safety of nuclear facilities, except for the domestic nuclear activities as described in this report, relates primarily to Emergency Preparedness and Siting aspects regarding the operation of nuclear power plants in Austria's neighbourhood.

Already in 1978, the Austrian electorate decided in a referendum not to start the operation of the constructed nuclear power plant (BWR) in Zwentendorf. In 1999, the Austrian parliament passed unanimously the Constitutional Law on a Nuclear-free Austria. It stipulates, inter alia, that installations which serve for energy generation by nuclear power must not be constructed, nor, if they already exist, come on line. Furthermore, the law prohibits the transport of fissile materials for purposes of nuclear power generation or disposal unless this would conflict with international obligations.

In view of the high risks emanating from nuclear power plants, Austria attaches utmost importance to international efforts to harmonise and steadily increase nuclear safety. Consequently, Austria has undertaken a number of bilateral activities with neighbouring countries with regard to the exchange of information on nuclear safety matters. This does not only include operational information on nuclear installations but also early warning schemes in the case of nuclear incidents or accidents and mutual assistance for the prevention or mitigation of effects from such radiological events.

As a Member State of the European Union, Austria has contributed and will continue to contribute to all activities aiming at continuously improving nuclear safety. During its Presidency of the Council of the European Union in the second half of 2018, Austria has initiated forward-looking conclusions with regard to Article 8e of the Council Directive 2014/87/Euratom (the "Nuclear Safety Directive").

Within the limits of a small country with no nuclear power programme, Austria endeavours to contribute also on international level to continuously improve nuclear safety. Together with regulators from research reactor regulatory authorities of Belgium, Germany and the Netherlands, Austria discusses regulatory experience in research reactor oversight, in the application of graded approach, and assist in exchanging information on challenges and good practices.

Austria conducted an IRRS mission in 2018 and currently implements first actions following the recommendations and suggestions as well as findings of the mission. Many of the actions remain to be implemented; as far as implementation is completed relevant information can be found under the pertinent chapters of this report.

C Article by Article Review

Article 6 Existing Nuclear Installations

Austria does not operate a nuclear installation as defined in Article 2 of the Convention. However, Austria has traditionally reported on its existing TRIGA research reactor facility, which is a nuclear installation as defined in the Euratom Nuclear Safety Directive.

The Vienna University of Technology operates a pool type TRIGA Mark II research reactor. It has a maximum steady state thermal output of 250 kW and pulsing capabilities up to 250 MW. Being in operation since March 1962, the reactor is exclusively used for basic and applied academic research and teaching purposes. As it is the closest research reactor to the IAEA headquarters, it is also frequently used by IAEA staff for development and calibration of safeguards instruments. In 2012 irradiated fuel elements from the core and the spent fuel storage were shipped to the Idaho National Lab and replaced by 78 19,9% enriched standard TRIGA fuel elements, which were loaned to the Vienna University of Technology by the US Department of Energy. With this new core the TRIGA research reactor went critical on 27 November 2012. These fuel elements will be returned to the USA after 2025, unless the parties of the contract agree upon an extension. Presently, the total number of fuel elements in the core is 80 (plus 5 fuel elements in the in-pool storage racks plus 5 fresh fuel elements in the fuel storage). The total activity of these fuel elements after one year of cooling time is 7.27×10^{13} Bq and after ten years approx. 1.5×10^{13} Bq. The Vienna University of Technology has a total spent fuel storage capacity of 168 fuel elements.

The reactor instrumentation, the control system, the primary and secondary cooling circuits, the reactor control room as well as the radiation warning system have undergone a major overhaul from April 2014 until April 2017. The operating license was suspended for the period of the refurbishment and re-established in autumn of 2016.

Within the relevant time period for this report no significant safety related issues or events have been recorded.

As the re-instrumentation of the reactor facility was extensive, there are no short to mid-term plans for other major system upgrades. While a decommissioning scenario for the TRIGA research reactor has been prepared and assessed, there are currently no plans for the decommissioning of the facility.

Article 7 Legislative and Regulatory Framework

Article 7 (1) Establishing and maintaining a legislative and regulatory framework

The legislative and regulatory framework comprises the legal areas of radiation protection, installation safety, safeguards and physical protection of nuclear material and nuclear facilities. As Austria is a Federal State, a number of federal (Bund), provincial (Länder) and district authorities (Bezirksverwaltungsbehörden) are involved in the regulation of these matters. While the legislation is made on the federal level, the execution is entrusted to the provincial or district authorities largely. Major nuclear installations or activities, however, are subject to federal authority and inspection. This applies in particular to the TRIGA research reactor.

The following acts form the primary legislative framework for nuclear safety:

Law Prohibiting the Use of Nuclear Fission for Energy Purposes, Constitutional Law on a "Nuclear-free Austria"

The use of nuclear energy for peaceful purposes in Austria has significantly been influenced by the passing of the Law Prohibiting the Use of Nuclear Fission for Energy Purposes in 1978 and of the Constitutional Law on a "Nuclear-free Austria" in 1999.

The Constitutional Law on a "Nuclear-free Austria" [BGBl. No. I Nr. 149/1999, BVG Atomfreies Österreich] prohibits the construction and operation of installations for the production of energy by means of nuclear fission as well as – with some exemptions – the transport of fissile materials in Austria. Where an international obligation exists, the international obligation would prevail. The use of installations for research and development activities is compatible with the quoted constitutional law.

Radiation Protection Act

The Radiation Protection Act [BGBl. No. 227/1969, Strahlenschutzgesetz] entered into force on 1 January 1971. The act regulates the handling of radiation sources, the operation of facilities and the radiation monitoring; this includes licensing, protection of workers and population, management of radioactive waste, natural radioactive material, radiological emergency management and nuclear safety. Since 2002 it has been amended several times to implement Euratom legislation.

Currently, the Radiation Protection Act and the Radiation Protection Ordinances are un-der revision in order to transpose the EU Council Directive 2013/59/Euratom laying down basic safety standards for the protection against the dangers arising from exposure to ionising radiation into national law.

The Federal Ministry of Education, Science and Research (BMBWF) has the sole responsibility for nuclear installations and particle accelerators within universities and research institutions of the Austrian Academy of Sciences as a competent authority responsible for licencing and supervision.

Federal Act on Civil Liability for Damage Caused by Radioactivity

The Federal Act on Civil Liability for Damage caused by Radioactivity (Nuclear Liability Act) [BGBl. I Nr. 170/1998: Atomhaftungsgesetz 1999] entered into force on 1 January 1999. The Act covers any damage to persons or property resulting from ionizing radiation due to nuclear installations, nuclear substances and radionuclides. Further coverable damages are the costs of the removal of impairments to the environment and the costs of preventing measures undertaken to avert immediate danger originating from nuclear installations, nuclear substances or radionuclides.

Article 7 (2) (i) National safety requirements and regulations

The following ordinances form the secondary legislative framework for nuclear safety:

General Radiation Protection Ordinance

The General Radiation Protection Ordinance [BGBl. II No. 191/2006: Allgemeine Strahlen-schutzverordnung, AllgStrSchVO] entered into force on 1 June 2006. The last amendment of this ordinance was in 2015. This legislation contains regulations in connection with radiation protection (dose limits, requirements for exposed workers, requirements for sealed und unsealed radioactive sources, requirements for research reactors, etc.). According to this ordinance, the prime responsibility for nuclear safety of a research reactor rests with the license holder. The General Radiation Protection Ordinance provides evidence of graded approach with regard to the authorization process (exemption from authorization and including specific provisions for research reactors, and high activity sealed sources).

Ordinance for Interventions in Case of Radiological Emergencies and in Case of Lasting Exposure

The Ordinance for Interventions in case of Radiological Emergencies and in case of Lasting Exposure [BGBl. II No. 145/2007: Interventionsverordnung] entered into force on 26 June 2007.

The ordinance contains regulations in connection with interventions in case of radiological emergencies and in case of lasting exposure from a past radiological emergency or a past practice. These include inter alia significant releases of radioactive material due to accidents involving facilities or practices, accidents during the transport of radioactive material or terrorist acts using radioactive material.

Ordinance on the Shipment of Radioactive Waste

The Ordinance on the Shipment of Radioactive Waste [BGBl. II Nr. 47/2009: Radioaktive Abfälle-Verbringungsverordnung] entered into force on 19 February 2009. With this ordinance, the EU Council Directive 2006/117/EURATOM on the supervision and control of shipments of radioactive waste and spent fuel was transposed into national law.

Radiation Protection Ordinance for Applications in Medicine

The Radiation Protection Ordinance for Applications in Medicine [BGBl. II No. 375/2017: Medizinische Strahlenschutzverordnung] entered into force on 8 February 2018.

Radiation Protection Ordinance for Air Crew

The Radiation Protection Ordinance for Air Crew [BGBl. II No. 235/2006: Strahlenschutzverordnung fliegendes Personal] entered into force on 1 July 2006. It comprises a set of special regulations for the radiation protection of persons who perform a function on board of an aircraft. Under this ordinance, aircraft operators are obliged to conduct an estimation and, in case of a possible exceedance of 1 mSv, an assessment of the dose of the air crew.

Ordinance for Naturally Occurring Radioactive Material

The Ordinance for Naturally Occurring Radioactive Material [BGBl. II Nr. 2/2008: Natürliche Strahlenquellen-Verordnung] entered into force on 7 January 2008. The ordinance contains regulations for the protection of persons against increased exposure due to practices with

natural radioactive sources (in accordance with the Radiation Protection Act) with the exemption of the concerns of air crew where a separate ordinance has been enacted.

The regulations are reviewed and revised by the regulatory authorities, in order to transpose into national legislation relevant European Directives.

Article 7 (2) (ii) System of licensing

The types of licensing are defined in Part II of the Radiation Protection Act (Sections 5, 6, 7 and 10) being further detailed by the General Radiation Protection Ordinance. Different types of authorisations are required by law for different stages of different facilities (construction and testing, and operation respectively), for handling of sources which do not need an installation and for radiation devices (type approvals). This constitutes a graded approach in the system of licensing. Siting and design are included in the construction stage, while decommissioning is included in the operation stage.

Pursuant to section 5 of the Radiation Protection Act, installations under the act require authorisation prior to the beginning of construction, including the design of the installations. According to section 6 an operating license is granted if the installation has been constructed in compliance with the specified conditions and obligations, if the radiation protection officer has been nominated and if the regular operation of the installation entails no hazard from ionising radiation. Section 7 regulates the licensing procedure for installations not requiring a construction permit, beyond of the scope of this convention. A concept for decommissioning and dismantling, a concept for the recycling or reuse of radioactive substances and the management of radioactive waste are obligatory for any installation.

The first step of the licensing process is the submittal of the request for a license. The licensing documentation, which becomes part of the licensing, shall include a detailed description of the intended handling of sources. Therefore, the licensing is issued only for the activities described in the application. Requirements on licensing differ for facilities and activities in cases where a construction license must precede the operation licence and for facilities and activities where no construction license is required. Necessary documents must be enclosed with the application for the granting of an operation authorisation. In the case of the TRIGA research reactor detailed description of the intended handling and its scope in connection with a safety analysis, an accident analysis and an emergency response plan is required. For facilities and activities with lower risk a graded approach applies.

In granting of an authorization for a facility or an activity, the regulatory body may impose limits, conditions and controls on the authorized party's subsequent activities. According to

the underlying regulations one of the conditions to obtain an operation authorisation is to designate a radiation protection officer with recognised qualification.

All authorization applicants are required to conduct a safety analysis and to submit a safety analysis report in support of the application. The general content of the safety analysis is specified in the law as listed among the requirements on authorization above. Detailed requirements are explicitly determined for radioactive waste management facilities and for research reactors in the General Radiation Protection Ordinance, where the content of the safety report is specified. For other facilities and activities, there are regulatory guides defining the necessary content of the safety analysis.

In case after the issuance of an operation or handling license, it is found that radiation protection is not sufficiently ensured despite of the fulfilment of all conditions and requirements, the competent authority may impose additional requirements for operation.

The Federal Minister of Education, Science and Research (BMBWF) is responsible for authorizations related to nuclear research facilities. The General Radiation Protection Ordinance requires that siting and design of a research reactor shall be authorized in accordance with the provisions by IAEA Safety Standard SSR-3. Siting and design are included in the construction phase. In order to obtain a construction license, a concept for decommissioning is required to be presented by the applicant. According to section 5(3) of the radiation Protection Act, the licensing procedure for construction also includes provisions for trial operation. This provision is also applicable for changes or expansions of the installation. Furthermore, the General Radiation Protection Ordinance prescribes obligations of the licensee with respect to the operation of the research reactor, including stipulations on the operating organization. Accordingly, the research reactor shall be staffed with

- reactor management;
- reactor operators, who need authorization;
- radiation protection officer and other radiation protection experts;
- nuclear safety officer and deputy officer

All of whom needing proof of having successfully participated in training in the specialised fields as required by the Ordinance.

The Radiation Protection Act requires a license for the construction and operation of a research reactor and explicitly prohibits the construction or operation without appropriate license. There are no exceptions to this requirement.

Article 7 (2) (iii) System of regulatory inspection and assessment

The Radiation Protection Act requires inspections by the responsible authorities to verify that the authorized party is in compliance with the regulatory requirements established in the Radiation Protection Act and the Radiation Protection Ordinance, as well as with the conditions specified in the authorization. The frequency of inspections are determined by the Radiation Protection Act. Facilities and activities inspected once a year for example, include research reactors, radioactive waste management facilities, high-activity sources and particle accelerators. The inspection frequencies prescribed by the Act are the minimum values. In case of planned changes that may significantly affect the safety of the facility or in case of significant deficiencies in the operation of the facility or in the activity, further inspections may be held. The inspectors have full access to any supervised facility or activity, at any time.

The regulatory authority of the research reactor (Federal Ministry for Science, Research and Economy) has established a formal process for inspection which includes inspection guidelines, as described in its Regulatory Supervision Handbook. An inspection programme is established every year and the annual inspection is announced. The methods to be used range from questioning, perusal and examination of the operator's documents/information/test plans all the way to on-the-spot inspections.

The inspection frequencies as prescribed by the law are the minimum values. Thus, for the research reactor there should be at least one inspection per year, but in case of planned changes or events that may significantly affect the safety or in case of significant deficiencies in the research reactor operation, there may be more than one inspection in a year. Prior to the inspection, the licensee is obliged to submit a set of documentation listed in the Regulatory Supervision Handbook (including e.g. annual reports on operation, on radiation protection, and on environmental monitoring, safety analysis report, report on training, test results and information on any safety related change in the operation of the research reactor). The authority and its expert(s) review and assess the submitted documents. During the inspection, the reports of the licence holder are discussed and any measures to be taken are recorded. In the extreme case when the inspection reveals that one or more of the conditions for granting the licence are not being complied with and there is an unacceptable risk to the health or life of humans, the operation shall be prohibited.

The outcome of an inspection is discussed between the inspector (technical expert) and the legal experts of the regulatory body as basis for enhancement of processes and the planning of topical inspections.

Article 7 (2) (iv) Enforcement of applicable regulations and terms of licences

Principles and practice of enforcement of legal and regulatory expectations are defined by section 18 of the Radiation Protection Act. Accordingly, in events of imminent danger, due to the handling of sources, the authority must arrange for all appropriate measures to avert this danger. For this purpose, it can issue preliminary injunctions and act in accordance with the provisions of the Administration Enforcement Act on substitute performance.

In addition, the Radiation Protection Act allows stipulating additional requirements for operation if so required to adequately ensure radiation protection or nuclear safety, even after the license has been granted.

The regulatory body takes enforcement actions in response to non-compliances with regulatory requirements. Enforcement actions stipulated by the legal background are mainly restricted to fines and the revocation of the licences in severe cases.

The Radiation Protection Act lists the fines for various unlawful acts/administrative offences, provided the act does not constitute a criminal offence within the jurisdiction of the courts and is not subject to more severe penalties according to other administrative provisions.

Article 8 Regulatory Body

While the oversight of the TRIGA research reactor rests with the Federal Minister for Education Science and Research, other authorities have purview over several aspects of radiation protection, which is summarised in Article 8(1) and (2) :

Article 8 (1) Establishment of the regulatory body

Responsibility for enforcing the radiation protection law is defined within section 41- 43 of the Radiation Protection Act. The Federal Minister of Science and Research, who heads the Federal Ministry of Education, Science and Research (BMBWF), is the authorisational and regulatory authority for nuclear reactors and particle accelerators at universities and research institutes of the Austrian Academy of Sciences (ÖAW). BMBWF supports the Federal Minister in the fulfilment of his or her functions as his or her auxiliary body.

The objectives of supervision are described within the supervisory handbook of the BMBWF (see article 10 for details). The supervision of the reactor is organized within a directorate of the BMBWF, the director of which signs on behalf of the minister. The authority consists of three legal staff members, one consultant and four external experts for the evaluation of technical questions related to radiation protection. In view of the comparably small number of authorized parties the number of qualified staff is sufficient. The department receives a budget reserved for regulatory activity, which is deemed sufficient for the tasks at hand. In the last three years there have been no changes in the number of staff or the available budget for the regulatory oversight.

The staff has to undergo regular training to maintain competence, the specifics of which are determined within the annual "appraisal interviews" (Mitarbeitergespräche) between superior and staff member. The director undergoes said interview with the Director General.

Results of regulatory activities are provided on the BMBWF's website where the public is informed, which regulatory tasks have been performed and major findings, if necessary.

Article 8 (2) Status of the regulatory body

As the regulatory oversight over the research reactor rests with the Minister for Education, Science and Research, the supervisory activity rest at the highest echelons of the government. The Minister may be held accountable by parliament, 5 members of which may pose inquiries on any subject under the Minister's purview at any time. Furthermore, the Austrian Court of Auditors may review any and all activities within a ministry, evaluate the performance efficiency and give recommendations on how to improve processes.

As other ministries also hold authority in certain fields of radiation protection (see above), the BMBWF has established permanent communication channels. For example, the Federal Ministry of the Interior, the Federal Ministry of Sustainability and Tourism and the Federal Ministry of Labour, Social Affairs, Health and Consumer Protection share authority for off-site emergency preparedness and response for radiation protection on the federal level and therefore are invited to inspection meetings and informed of its results regardless of attendance.

Article 9 Responsibility of the Licence Holder

Nuclear Third Party Liability

The liability for nuclear installations and nuclear substances is governed by the Act on Liability for Damage Caused by Radioactivity[1] of 1999. The Act covers any damage to persons or property by ionizing radiation from nuclear installations, nuclear substances and radionuclides. Further coverable damages are the costs of the removal of impairments to the environment and the costs of preventing measures undertaken to avert immediate danger originating from nuclear installations, nuclear substances or radionuclides. In this context, impairment to the environment means any interference with the environment, which lastingly alters the latter in such a way that it differs noticeably from natural processes either in quantity, in quality or in the temporal respect. Only the impairment which is of some significance is to be compensated.

The liability both of the operator of a nuclear installation and the carrier of nuclear substances does in principle not presuppose any negligence on their part. Accordingly the Act lays down as a rule the strict liability of the said persons. The operator of a nuclear installation is liable for all harm caused by operating the installation. Not only damages resulting from an accident during operation are covered, but also any damages in the ordinary course of operation (i.e. without any sudden incident). The carrier of nuclear substances is liable for damages caused by an accident during carriage. In addition he has to remedy any other harm caused during carriage (thus likewise independently of a possible incident).

The Act on Liability for Damage Caused by Radioactivity of 1999 designates in principle the unlimited liability of the person liable.

The Act also provides liability rules for the handling of radionuclides. Also in these cases the amount of compensation is in principle unlimited. The holder of the radionuclide, however, is liable only if he is to be blamed for negligence, since in these cases damage normally cannot reach dimensions comparable to those caused by nuclear installations or the substantially more dangerous nuclear material. Due to the yet given specific danger of radionuclides the burden of proof is shifted from the injured party to the holder of the radionuclide.

[1] Bundesgesetz über die zivilrechtliche Haftung für Schäden durch Radioaktivität (Atomhaftungsgesetz 1999 – AtomHG 1999, BGBl. I No. 170/1998)

Furthermore, the Act abandons the principle of „channelling" of nuclear liability currently governing the international conventions on the subject-matter. That means that compensation cannot only be claimed from the operator of an installation, but the injured party can also take legal action against third parties, e.g. the supplier and the constructor. This is meant to make sure that the person injured can recover all damages even if it is more than the operator can pay.

To provide security for the claims of possible injured parties, the Act on Liability for Damage Caused by Radioactivity of 1999 obliges the following persons to effect liability insurances: the operator of a nuclear installation situated in Austria (insurance appr. 400 million Euro plus 40 million Euro interests and costs), the carrier of nuclear substances and the holder of a radionuclide with an activity of more than 370 GBq. Minimum amounts insured shall guarantee that all foreseeable hazards can be covered.

Taking into consideration that Austria is a party neither to the Paris Convention nor to the Vienna Convention and the Convention on the Supplementary Compensation, section 23 of the Act contains special rules for international cases. Whereas pursuant to section 48 of the Austrian Act on Private International Law non-contractual damage claims are governed by the law of the state, in which the act causing the damage was committed, section 23 (1) of the Act on Liability for Damage Caused by Radioactivity of 1999 provides that the person injured by ionizing radiation can demand that Austrian law be applied to claims for damages which occurred in Austria. If vice versa the incident causing the harm has taken place in Austria and thus Austrian law is applicable, damages which occurred abroad are only covered according to Austrian law as far as compensation is also provided for by the personal statute - usually the lex patriae - of the injured party.

Concerning the Paris and the Vienna Convention as well as the Convention on Supplementary Compensation on Liability for Nuclear Damage, Austria has mainly two concerns: First the maximum liability amounts seem to be insufficient; in contrast the Austrian Act on Liability for Damage Caused by Radioactivity of 1999 provides for unlimited liability combined with obligatory liability insurance covering relatively high amounts of damage. Secondly the channelling of liability according to which only operators and not also suppliers can be held liable seems inadequate. Above that, the prescription rules and the rules regarding the place of jurisdiction are to the detriment of potential victims.

Article 10 Priority to Safety

The summary under this article provides an overview of how safety is prioritized in context of the TRIGA research reactor as the only installation under the scope of this report. Therefore, other installations and authorities will not be discussed.

Safety policies

As of the writing of this report, no comprehensive national policy and strategy for safety has been established. This was identified as a finding during the IRRS Mission to Austria in June 2018 and the Action Plan will address this issue as well.

Nevertheless, safety policies regarding the Research Reactor have been established within the supervisory handbook:

The primary objective is to protect humans and the environment against the risks of nuclear energy and the harmful effects of ionising radiation. Minimising the radiation exposure of employees and excluding any unauthorised radioactive release into the environment take top priority. That has resulted in the mission to ensure continuous monitoring of the nuclear installations (i.e. the TRIGA research reactor) and facilities producing ionising radiation (particle accelerators), environmental radioactivity and radiation protection.

To complete this mission, the following strategy is employed:

- supervising nuclear installations and facilities for the production of ionising radiation
- warranting radiation protection and supervision of environmental radioactivity
- effectively managing experts for the implementation of inspections
- cultivating productive cooperation with operators
- optimising public relations and transparency
- improving emergency management, including precautionary radiation protection
- initiating and supporting safety improvements

Safety Culture

Pursuant to section 89b(6) of the General Radiation Protection Ordinance (AllgStrSchV), the license holder shall ensure a high safety culture in all the installation's areas and at all organisational levels.

In the context of supervision, the topic of safety culture is handled as follows:

Human factor and human-technology interface:

As a result, supervision of the "human factor" focuses on expertise and the sense of responsibility of the persons responsible and the staff otherwise engaged, which is why special attention must be paid to the completion of the applicable mandatory training of employees in the area of radiation protection.

Safety in connection with operational experience

In the context of the analysis of events, the Vienna University of Technology checks the extent to which human conduct or the human/technology interface was relevant for the event and whether optimisations are required. This takes place in the context of the at least annual meetings of the reactor safety commission. In the context of the annual regulatory interview pursuant to section 17 of the Radiation Protection Act (StrSchG), the nuclear safety officer reports about this as the occasion arises.

Safety due to the organisation

In the context of the repeat tests, experts also assess safety culture with the help of targeted discussions or specific questions in the context of the annual regulatory interview pursuant to section 17 of the Radiation Protection Act (StrSchG) with the management of the TRIGA research reactor based on the review questions as determined within the supervisory handbook.

Management System

According to section 89a(2) General Radiation Protection Ordinance (AllgStrSchV), the license holder is obliged to set up and apply a management system with the aim of warranting nuclear safety (section 89a.(3)-(10) leg. cit.) of the installation at all times.

The description of the management system is part of the safety report pursuant to Annex 14 lit. A of the General Radiation Protection Ordinance (AllgStrSchV).

This system requires authorisation from the regulatory authority and is checked by the BMBWF on a regular basis.

Basic principles are defined within the supervisory handbook: The management system must comprise all activities and facilities with a bearing on nuclear safety. This must be given highest priority. In addition, it must take into account other requirements of the operator of the research reactor, including operating safety or the performance of experiments.

Work operations are part of the management system and reviewed through the repeat test plan: This plan specifies all the processes, installations and facilities that warrant the reactor's nuclear safety and includes inspection criteria. The proper implementation of the inspections and their results need to be reviewed by the competent persons (management, radiation protection, nuclear safety). Any required maintenance or repairs will be commissioned, monitored and documented by the nuclear safety officer.

A regulatory review of the management system includes

- in addition to verifying compliance with the defined requirements in terms of scope and content of the management system and the operator's report, verifying the plausibility of any representations made,

- recognising trends by analysing parameters,

- assessing whether the management system is being applied to improve safety and promote the safety culture

- determining ambiguities and further concerns within the scope of the annual consultation pursuant to section 17 of the Radiation Protection Act (StrSchG).

Safety assessments

The safety of the reactor facility is reviewed annually during the meetings and accompanying inspections according to section 17 of the Radiation Protection Act (StrSchG).

Pursuant to section 89a(10) General Radiation Protection Ordinance AllgStrSchV the license holder has to conduct a periodic safety review every 10 years. The contents of this review are determined in Annex 14 letter C of said ordinance and results of this review are to be submitted to the BMBWF, with the first-time submission having taken place in December 2014.

In transposing the European Council's Nuclear Safety Directive, section 87b(1) AllgStrSchV was established, which stipulates a review of the legal framework and the regulatory authorities by international peers every 10 years. In order to comply with that requirement, Austria requested an IRRS Mission, which took place in June 2018. The recommendations and suggestions received are currently under review in order to decide how to best generate an action plan reflecting these results.

Article 11 Financial and Human Resources

Article 11 (1) Financial resources

The TRIGA research reactor is embedded in the Atominstitut of the Vienna University of Technology. Thus, the university provides funds for staff, equipment, research and safety of the facility. The regular budget plus additional third party income assure the profound financing to operate the reactor in a safe and efficient way; overall priority is given to the safety of the TRIGA research reactor. All relevant safety measures have to be covered by the regular budget.

The Vienna University of Technology budget is provided through performance agreements with the BMBWF as well as third party allocations (the latter being much less significant). These public contracts are renegotiated every three years and provide the university with a global budget, which is not subdivided any further and is distributed by the university according to budgetary needs. The BMBWF has no say on the discretionary spending of the universities as they have been granted far reaching autonomy through the Federal Constitution.

The Vienna University of Technology as well as the Federal Real Estate Agency (Bundesimmobiliengesellschaft – the property owner of the reactor site) have made provisions in their respective balance sheets to provide for the eventual decommissioning of the research reactor, as this will require a significant investment.

Article 11 (2) Human resources

While the Vienna University of Technology is free to allocate personal resources at her discretion, certain obligations may be derived from the legal framework: According to section 89(1) General Radiation Protection Ordinance (AllgStrSchV), the license holder is obliged to specify allocation to the following functional groups, the distribution of the key tasks and the transfer of responsibilities:

1. reactor management (all supervisors of reactor operators who have the authority to issue directives)

2. reactor operators (persons authorised to operate and monitor the reactor in the defined scope);

3. radiation protection officer and persons entrusted with ensuring radiation protection;

4. nuclear safety officer and his or her deputy.

Therefore, all critical functions for the safety of the facilities are stipulated by legal requirements.

The regulatory monitoring of the specialist knowledge of the persons responsible and of the staff otherwise engaged is very important, because the staff's knowledge and expertise constitute the basis for human performance and thus for the safe conduct of reactor operations.

Section 43 General Radiation Protection Ordinance (AllgStrSchV) "Education and training in the field of research reactors" establishes the requirements related to the training and expertise of the radiation protection experts appointed and for further persons entrusted with ensuring radiation protection.

Section 89(2) and (3) General Radiation Protection Ordinance (AllgStrSchV) establishes the requirements related to the training and expertise of the nuclear safety officer to be appointed for the operation of the research reactor, such officer's deputy and of the reactor management as well as of the reactor operators required for operation of the research reactor.

As regards the persons otherwise engaged, the operator shall be required to provide to the regulatory authority evidence of possession of knowledge required for the safe operation of the TRIGA research reactor, of the possible dangers and the protective actions to be taken, provided such knowledge is necessary for the proper performance of the respective activity at the relevant workplace and for the protection of the individual.

The Vienna University of Technology also provides academic training for nuclear physicists, which guarantees the national supply of experts in nuclear science, which, considering the size of the nuclear activity in the country is not that excessive to begin with.

Article 12 Human Factors

The human factor is taken into account on all levels of institutional and regulatory oversight as follows:

- Licensing: review of the materials inasfar the human factor is appropriately accounted for.

- Regulatory oversight: how is the human factor being addressed in safety and review instruments (ie safety report, safety analysis report, topical peer review, etc.)?

- Event analysis: identification of all the factors contributing to the event, including analysis of human error.

The BMBWF's handbook takes the human factor into account, which is included in serval regulatory activities and check-ups, for example within the repeat inspection sheets.

Feedback from findings on the human factor are discussed during oversight meetings or during procedures according to section 17 of the Radiation Protection Act (StrSchG).

Article 13 Quality Assurance

Pursuant to section 89a(5) AllgStrSchV the license holder is required to establish and apply quality assurance systems, which best serve to optimise radiation protection and nuclear safety. Therefore, the aim of quality assurance is maintaining and optimising safe operation of the TRIGA research reactor. The licence holder is responsible for quality assurance.

The BMBWF's Handbook further specifies, that quality assurance needs to include several areas: internal organisation, cooperation of companies involved (especially procurement), staff qualification, planning, production, assembly and construction, commissioning, measuring and test equipment, procedure in the event of safety relevant anomalies, and documentation and archiving.

The quality assurance management is monitored during the annual section 17-procedures. Templates on how to document and record the monitoring have been established alongside the BMBWF's handbook.

Article 14 Assessment and Verification of Safety

Article 14 (1) Assessment of safety

Initial review and assessment is conducted by the regulatory body as part of the authorization process and it is required that qualified experts must be consulted in the review and

assessment process. The purpose, scope and criteria for review and assessment throughout the lifetime of the installation are derived from the Radiation Protection Act.

Pursuant to section 5(5) of the Radiation Protection Act a precondition for a construction and operation licence is the existence and positive assessment of a safety analysis report (SAR), which is prescribed by the General Radiation Protection Ordinance. The SAR for the research reactor includes, in compliance with the relevant IAEA requirements

- a detailed description of the reactor site, of the reactor, and of all facilities and activities with safety significance;
- the general safety principles and criteria to be applied to the design;
- the analysis of potential hazards associated with operation of the reactor;
- the safety analyses of the potential accident sequences;
- safety features to avoid or minimize likelihood of accidents or mitigate consequences in accordance with the defence in depth concept;
- information for establishing the operational limits and conditions (OLCs) for the reactor;
- conduct of operations; and
- details on the emergency plan of the research reactor.

The SAR has been updated several times in the past. The last update took place in 2017 necessitated by relevant modifications to the reactor systems (i.e. reactor instrumentation and control system, ventilation system, area monitoring system). A periodic update of the report is mandated by the legal framework.

Aside from a high technical standard of the research reactor and reliable and qualified staff, events that have occurred must be systematically documented and analysed in order to learn from them and to continue improving safety.

The process of event analysis and experience feedback ensures that all events relevant for the TRIGA research reactor in Vienna with regard to the development of contributing factors from humans, technology and organisation are analysed and that something is learned from them and, if necessary, that measures are initiated for the TRIGA research reactor in Vienna.

Instruments for event analysis and experience feedback include the repeat test plan, which also defines the daily rounds and the routine inspections related to radiation protection, and the regular meetings at the TRIGA research reactor in Vienna.

The performance of event analyses and of the measures derived from them is subject to regulatory review through analysis of the annual operator report.

A critical role is provided by the nuclear safety officer. The nuclear safety officer is appointed in accordance with section 89b(1) General Radiation Protection Ordinance (AllgStrSchV) in writing by the authorisational and regulatory authority. Any such appointment requires the appointee's consent. Pursuant to section 89b(2) General Radiation Protection Ordinance (AllgStrSchV) the nuclear safety officer should be entrusted with the tasks that need to be performed to warrant the nuclear safety of a research reactor. In particular, these are

- the regular inspection of the installation's technical facilities,

- notification of the license holder without undue delay of any shortcoming with respect to nuclear safety,

- development of improvement and retooling measures on the basis of the inspection results, the officer's operating experience and the exchange of experience with the nuclear safety officers of comparable installations,

- the drafting and ongoing update of the safety report and the emergency response plan in collaboration with the radiation protection officer,

- the documentation and analysis of incidents that qualify as notifiable events and other anomalies,

- participation in the development of operating rules and in the fulfilment of recording and notification obligations for matters relating to nuclear safety and

- participation in the planning of changes to the installation or its operation.

Furthermore, pursuant to section 89b(5) General Radiation Protection Ordinance (AllgStrSchV), the nuclear safety officer shall be responsible for the documentation and analysis of incidents that qualify as notifiable events and other anomalies.

Pursuant to section 89c para 2 General Radiation Protection Ordinance (AllgStrSchV), the general operating rules of the TRIGA research reactor shall include measures in the case of safety-relevant events, criteria for notifiable events as well as event detection and process

description in case of incidents and the measures to be taken to avoid event progression and limit the safety impacts.

Findings are to be reported to the regulatory authority. The operator provides an event analysis for both internal events (notifiable events in accordance with INES and those below the notification threshold) and external events that could also be relevant for the TRIGA research reactor.

Internal events of the operator (notifiable events in accordance with INES and relevant events below the INES notification threshold) are reported directly to the regulatory authority. Measures are taken in consultation with the authority. There have been no events or near misses in the reporting period.

External events are communicated to the TRIGA research reactor in Vienna primarily via the Research Reactor Operators Group (RROG), the Arbeitsgemeinschaft Forschungsreaktoren (AFR) and informal exchanges with IAEA and other reactor operators.

As the occasion arises, external events are discussed directly and summarised in the context of the at least annual meeting of the reactor safety commission and reported by the nuclear safety officer during the annual regulatory interview pursuant to section 17 Radiation Protection Act (StrSchG).

Article 14 (2) Verification of safety

The Vienna University of Technology has to prepare several documents for information and transparency, for traceability, documentation and as a working basis for the employees, the authority and as a basis for emergencies. As an example, The Vienna University of Technology, as required by the legal framework has defined operating regulations, an operating manual, a repeat inspection plan, as well as a written documentation about the reactor operation. This documentation has to be maintained as long as the reactor is operating. Further documents that have been established are training documents, teachings on the installation, documents about the regular calibration of the instruments, documents about the dosimetry or lists concerning any of the radioactive sources at the installation. Occupationally exposed persons in categories A and B at the Vienna University of Technology have to wear dosimeters and are monitored; persons of the category A have to be monitored by conducting medical examinations, which have to be documented. The licensee has to provide appropriate protective clothing, to lay down the radiation areas and mark the escape routes. The license holder has to lay down the competences of the employees, their access to the different areas of radiation exposure. A new radiation warning system has been installed, the environment has to be monitored by itself and by outside experts by taking samples and measuring them in a regular interval. An on site emergency diesel generator has been

installed and an emergency plan regulates the steps in an emergency case. Current events have to be reported immediately.

All these measures intend to keep the highest standards of safety on-site. The BMBWF, as the competent authority, through its experts checks the reports and documentation as described above in the context of the annual inspections and review procedure or on an as-needed basis and verify the accordance to the safety requirements and OLC set through the licence and the legal requirements. Any proposed modification that might significantly affect the safety is subject to a review and assessment prior to approval by the regulatory body.

Review and assessment plans and priorities are established by the Regulatory Body on an annual basis and communicated to the licensees.

Article 15 Radiation Protection

The Radiation Protection Act and the General Radiation Protection Ordinance form the legal basis for operational radiation protection for all kinds of applications of ionizing radiation (and therefore also for research reactors) in Austria. This legislation aims at protecting human life and health and the environment against the danger of ionising radiation. It is based on the requirements of the European Basic Safety Standards, IAEA Basic Safety Standards and on recommendations of the International Commission on Radiological Protection (ICRP). The international agreed principles of justification of a practice, optimisation of radiation exposure and dose limitation are implemented in the legislation. Further radiation protection requirements are defined in non-binding national standards (Austrian Standards International). Specific obligations for the license holders are stated in the construction and operation licences granted to each operator of a nuclear facility. All activities must be performed in accordance with radiation protection regulations and the obligations in the licences.

The Austrian 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 (section 4 of the Radiation Protection Act and section 3 of the General Radiation Protection Ordinance). It is the responsibility of the license holder to optimize the radiation doses for its licensed practice and to implement a system for control.

According to the Radiation Protection Ordinance, the dose limit for individuals of the population 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. According to section 34 of

the Radiation Protection Act the exposure of occupationally exposed persons shall be monitored systematically on the basis of individual measurements. The external exposure resulting from the handling of sources shall be assessed using personal dosimeters. For the case that an occupationally exposed person handles unsealed radioactive substances in the course of his or her activity, routine intake monitoring shall be implemented if the committed effective dose resulting from intake on account of such handling may exceed the limit for members of the public. The analysis of this individual dose monitoring and of incorporation monitoring may only be conducted by an accredited dosimetric service.

The dose limits and working conditions for underage persons and pregnant women are laid down in section 12 of the General Radiation Protection Ordinance. As a general rule, the Radiation Protection Act states that pregnant women and underage persons may not be assigned to any work which would result in being occupationally exposed workers. Nursing women may not be assigned to any work that contains handling with radioactive materials subject to licensing when there is an imminent danger of incorporation.

For limitation of the public exposure Austria has a dose constraint of 0.3 mSv/year for the controlled discharge of gaseous or liquid radioactive material. In the licence application for construction and operation of a facility, the technical measures, i.e. barriers and air filters, which are 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 to atmosphere and water bodies is monitored by the license holder and supervised by the licensing authority. The inspection of the nuclear installations by the authorities concerning emission and immission 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 authority. Investigative measurements by the authorities of gaseous and liquid emissions and the internal surveillance by the operators show that maximum permissible levels were never exceeded. Also environmental monitoring in the surroundings did not detect any inadmissibly gamma dose rates or immissions during operation of the research reactor.

The competent authority controls the implementation of the principle of optimisation and the implementation of the radiation protection programme by the license holder in the frame of annual inspections according to section 17 of the Radiation Protection Act..

Article 16 Emergency Preparedness

Article 16 (1) Emergency plans and programmes

The Radiation Protection Act establishes the main responsibilities of the competent authorities in case of radiological emergencies. The General Radiation Protection Ordinance and the Ordinance on Interventions in Emergency Exposure Situations and in Existing Exposure Situations specifies in detail, as do subsequent documents like the Austrian National Radiation Emergency Plan and the Austrian Catalogue of protective actions.

The off-site EPR arrangements are determined in detail at federal level by the ***Austrian National Radiation Emergency Plan*** and at regional level by the ***emergency plans of the Austrian Federal Provinces***. On-site EPR plans have to be prepared by the license holder and are part of the licensing process.

The ***specific responsibilities*** related to EPR follow from their responsibilities set by the legislation related to nuclear and radiation safety:

The ***Federal Minister of Sustainability and Tourism*** (BMNT) has a 24/7 on call duty service for notification of radiological events. It is responsible for the evaluation of consequences in case of radiological emergencies, classification of the emergency, the decision on protective actions (with participation of the Federal Minister of Labour, Social Affairs, Health and Consumer Protection) and communication (other federal competent authorities and the public). The responsibility also includes governmental monitoring of large-scale radioactive contamination of the environment as well as acting as the Competent Authority for international information exchange (ECURIE, Convention on Early Notification and bilateral agreements).

The ***Federal Minister of Labour, Social Affairs, Health and Consumer Protection*** (BMASGK) is responsible for assessing the radioactivity of food, the management of ITB and participates in the decision making process in case of an emergency.

The ***Federal Minister of Education, Science and Research*** (BMBWF) as regulatory body for the research reactor has to review the on-site emergency response plan of the research reactor as well as to receive notifications in case of an emergency at the research reactor.

The ***Federal Minister of the Interior*** (BMI) is responsible for the co-ordination of the National Crisis and Disaster Management and for the international disaster relief, staffing and maintaining the Federal Alarm Centre, which is serving as national information platform and

24/7 Contact Point for information exchange (in the field of radiation protection: ECURIE, Convention on Early Notification and bilateral agreements).

The nine ***Austrian Provinces*** are responsible for the implementation of protective actions as well as developing and maintaining the response plans on provincial level (based on the National Response Plans).

The legal framework assigns to the authorized party the responsibility for the ***on-site Emergency Preparedness and Response***. The required content of the on-site emergency response plan for the research reactor is established in Annexes of the General Radiation Protection Ordinance. The regulatory body evaluates the EPR arrangements of the authorized party during the licensing process, whereas the prospective authorized party has to submit with the application for license a radiation protection programme, which includes an emergency response plan. Additionally, it is required that the authorized party notifies the regulatory body immediately about any emergency and has in place a system for response to an on-site emergency.

For the ***research reactor***, the emergency response plan is included in the Safety Analysis Report and the General Radiation Protection Ordinance requires an update of the Safety Analysis Report whenever a significant change is planned to be approved by BMBWF.

The regulatory authority (BMBWF) ***reviews and assesses*** the on-site EPR arrangements of the licence holder (Vienna University of Technology) to verify compliance with the regulatory requirements before issuing the authorization for the conduct of the activity.

The license holder is obliged to report any incidents of safety significance to the regulatory body. In addition, the TRIGA research reactor is a ***member of the incident reporting system*** for research reactors of the IAEA (IRSRR) and has established a model reporting and evaluation system, which has been transferred to other TRIGA research reactors through IRSRR.

According to the hazard assessment and emergency preparedness categorization, the TRIGA research reactor is a category III facility. ***Off-site*** protective actions to be taken into account for EP category III facilities are part of the Austrian National Radiation Emergency Plan Part 3: "Accidents in Austrian nuclear and radiological facilities". These protective actions are based on the safety reports and hazard assessments.

Part 1 of the Austrian National Radiation Emergency Plan addresses ***accidents in Nuclear Power Plants outside of Austria*** (category V). A systematic hazard assessment for potential

NPP accidents covering all NPPs within a distance of 400 km to Austrian borders was performed. Assuming different accident scenarios, including also severe accidents with releases in the order of Fukushima, the radiological impact to Austrian territory was analyzed for different weather conditions. Based on the results optimized protection strategies have been developed. In addition, the recommendations of the HERCA-WENRA approach were taken into account. No "emergency planning zones" but "emergency planning distances" (see definitions in IAEA GSR-Part 7) of NPPs lie on Austrian territory. The protection strategies are part of the Austrian Catalogue of Protective Actions.

In the urgent phase of a nuclear or radiological emergency the ***coordination between different responsible authorities in Austria*** is realized by well-established information pathways and procedures and an Internet based electronic situation reporting platform with restricted access for all responsible authorities. NCAs from neighbouring countries have access to the Austrian system as BMNT has access to similar systems in neighbouring countries.

Several types of ***emergency exercises*** on international, bilateral, national and local level help to improve the emergency preparedness system and keep the emergency personnel trained. Requirements for conducting exercises are part of the Ordinance on Interventions. A more detailed exercise plan is part of the Austrian National Radiation Emergency Plan, listing the regular exercises with Austrian participation. This includes ConvEx (IAEA), ECURIE (EU), INEX (NEA/OECD), bilateral or regional exercises, national exercises, local exercises conducted by the Austrian Provinces or first responder organizations and specific exercises performing tasks related to emergency monitoring, sampling or analyses.

Note that in the course of the current revision of the Radiation Protection Act it is planned to introduce all the requirements by the IAEA GSR Part 7 Safety Standard with regards the national emergency management system. A new ordinance is also planned to be issued, giving the (on-site) EPR requirements for all category III and IV facilities.

Article 16 (2) Information of the public and neighbouring States

Different provisions exist for ***informing the Austrian population*** in case of a radiological or nuclear emergency. In case of an emergency, the competent federal authorities will provide urgent information to the public together with the recommendations of protective actions. If necessary, representatives of the Austrian Broadcast Corporation (ORF) and the Austrian Press Agency (APA) will extend the coordination board of the National Crisis and Disaster Management. A call-center can be activated on short notice. Public leaflets on radiation protection, emergency management and protective actions are available (www.strahlenschutz.gv.at). According to the Ordinance on Interventions, additional

information prior and in case of a radiological emergency is provided on the homepage of the BMNT.

The exchange of information in case of a radiological or nuclear emergency with the ***competent authorities in the neighbouring countries*** is guaranteed by three information systems: Austria fulfils the obligations of the Convention on Early Notification of Nuclear Accidents (IAEA), is part of the ECURIE information exchange system organized by the European Commission and has bilateral agreements with all neighboring countries operating nuclear power plants. Austria has been striving for years to extend the bilateral and regional co-operation, which resulted, among others, in automatic exchange of information between emergency centers relevant for assessing the impact of a radiological or nuclear accident (such as dose rate measurements and source term information) and joint emergency exercises.

Data gathered by the Radiation Early Warning System are exchanged on-line with the corresponding systems in most of the neighboring countries (Slovenia, Slovakia, Czech Republic, Hungary, Germany and Switzerland) on the basis of bilateral arrangements. In parallel, exchange of these data is run on European level via the EURDEP system among the EU member states.

The ***Austrian Radiation Early Warning System*** (Strahlenfrühwarnsystem) continuously monitors ambient gamma dose rates with more than 300 measuring stations throughout the country. In addition, 10 aerosol-monitoring stations have been installed near the Austrian borders. The measurement data of these automatic on-line systems are transmitted to the National Centre at BMNT and to nine provincial centers located in the provincial capitals. The on-line data of about 100 stations of this system are accessible to the public via internet (www.strahlenschutz.gv.at) and on the Austrian Broadcast (ORF) Teletext service.

In addition, a ***laboratory-based monitoring network*** performs a radionuclide-specific routine monitoring of air, precipitation, surface water bodies, feed- and foodstuffs. In addition, an emergency sampling concept is available.

The BMNT is also obliged to operate adequate ***decision support systems*** (i.e. RODOS) based on meteorological forecast data. The information provided by the accident country (source term, other release parameters) is the basis for a prognosis of possible consequences. The environmental monitoring measurement results and the results of the decision support systems provide the basis for assessing the radiological situation and deciding on protective actions.

Article 16 (3) Emergency preparedness for Contracting Parties without nuclear installations

On-site-emergency exercises are performed at the research reactor following their emergency plan pursuant to the radiation protection act and the general radiation protection ordinance .

The last exercise took place on November 27th 2018 under participation of the fire brigade and rescue teams simulating a radiation accident of a staff member reviewing the implementation of the schedules and the coordination. Representatives of several authorities took part as observer.

Those operations have to be evaluated by the involved teams-the findings will finally be discussed with the legal authority to improve the processes.

The BMBWF as competent authority has determined that emergency exercises need to be held annually, the scope of which being determined between licensee and authority.

Article 17 Siting

Article 17 (1) Evaluation of site related factors

The General Radiation Protection Ordinance requires that siting of a research reactor shall be authorized in accordance with the provisions by the IAEA Safety Standard SSR-3. Specifically, with regard to the site assessment, the underlying criteria, the evaluation of external site-related hazards, particularly as a consequence of extreme meteorological events, earthquakes or anthropogenic factors, and the appraisal of the impact the planned installation will have on the environment and the population the requirements set by SSR-3 are relevant.

As there are currently no plans to establish new nuclear installations there have been no activities concerning siting during the reporting period.

Article 17 (2) Impact of the installation on individuals, society and environment

According to the Euratom Nuclear Safety Directive the Austrian legislation stipulates in section 5 (2) and (5) of the General Radiation Protection Ordinance an obligatory evaluation

of the potential impact of a planned research reactor on the individuals, the population and the environment according to the requirements set by the IAEA Safety Standard SSR- 3.

As there are no plans to establish new nuclear installations this is currently of very low practical relevance in Austria.

The operating license of the TRIGA research reactor includes a requirement on the regularly reporting of environmental monitoring and of "dosimetry for measuring external and internal radiation exposure of people" to the regulatory body and is part of the yearly inspection process according to section 17 of the Radiation Protection Act. So far, no irregular activities or exceedances of dose limits have been reported.

Article 17 (3) Re-evaluation of site related factors

No reevaluation has taken place during this reporting period.

Article 17 (4) Consultation with other Contracting Parties likely to be affected by the installation

Since the major overhaul from April 2014 until April 2017, (regarding the reactor instrumentation, the control system, the primary and secondary cooling circuits, the reactor control room as well as the radiation warning system) Austria reports regularly on its reactor in the course of the Bilateral Nuclear Experts Meetings according to its bilateral agreements (see Annex) . Austria has pertinent bilateral agreements in place with all Contracting Parties likely to be affected by its research reactor. The EU directive on transboundary Environmental Impact Assessments and the ESPOO Convention are fully transposed into Austrian law.

Article 18 Design and Construction

Article 18 (1) Implementation of defence in depth

Design of a research reactor shall be done in accordance with the IAEA Safety Standard SSR-3, as required by the General Radiation Protection Ordinance. This fact naturally ensures full compliance of the TRIGA research reactor design requirements with those stemming from the IAEA Safety Standards. Siting and design are included in the construction phase.

As there are currently no plans to establish new nuclear installations there have been no activities concerning siting during the reporting period.

Article 18 (2) Incorporation of proven technologies

See Art.18(1).

Article 18 (3) Design for reliable, stable and manageable operation

See Art.18(1) .

Article 19 Operation

Article 19 (1) Initial authorization

Within the framework of the Austrian legislation, a license is granted after an application. The General Radiation Protection Ordinance requires that siting of a research reactor shall be authorized in accordance with the provisions by the IAEA Safety Standard SSR-3. Specifically, this has to be done regarding the site assessment, the underlying criteria, the evaluation of external site-related hazards, particularly as a consequence of extreme meteorological events, like earthquakes or anthropogenic factors, and the appraisal of the impact the planned installation will have on the environment and the population.

Siting and design are included in the construction phase, while decommissioning is included in the operation phase (i.e. decommissioning of the reactor will be performed based on the operation license, amended accordingly).

The construction of a research reactor legally requires the prospective licensee to include documentation on how the above-mentioned criteria are being met. In the run-up other relevant permits (i.e., building permit according to the building code) need to be secured. The responsibilities have to be laid down in a transparent way and the license holder has to draft and apply several written documents laying down the frame of the safety criteria for the working procedures and how to report on relevant topics. The construction authorisation may include testing requirements. Installations may be operated on the basis of an operation authorisation which shall be granted if all conditions stipulated in the respective regulations are fulfilled, and after eventual inspection and testing of the installation (if so required);

In order to obtain the operation license, the application shall enclose, among others, evidence of fulfilment of the conditions prescribed in the construction authorisation, including the testing requirements (i.e. a description of the activities that were conducted in order to fulfil the conditions included in the construction license. A description, on how the requested tests have been conducted, a written confirmation that all conditions included in the construction license are fulfilled, as well as all other technical documents are required for obtaining the operation license.)

Issued licenses are reconsidered during the lifetime of a facility / duration of the activity if required.

Licenses do not expire over time, however, under the current revision of the law, it is planned to introduce limited validity periods for some licenses. Expiration dates are set for the construction licenses only, in terms of the period allowed by the authority from the issuance of the authorisation and the start as well as the end of the construction, and for the construction period. The modification of authorisations is required by law in case of any change or extension of the facility that may result in additional radiation risks.

According to the Radiation Protection Act further types of authorizations required for the Research Reactor are licenses for construction and testing, licenses for operation and approval for clearance. Commissioning requirements set for new facilities or components of new facilities are reviewed during the Art 17 procedures.

In order to obtain a construction license, the applicant must present a concept for decommissioning. The content of the decommissioning concept is prescribed in the General Radiation Protection Ordinance, while decommissioning shall be conducted in accordance with the provisions by the IAEA Safety Standard SSR-3. Furthermore, for obtaining a construction license for an installation, adequate provisions have to be made also for the disposal of radioactive waste.

At present, there are no plans for construction of a new research reactor, therefore siting and design license applications are not expected in the near future.

In accordance with the operation license a detailed SAR has to be submitted which has been updated several times during the past. The last update of which has been done in 2017 according to relevant modifications in the reactor systems (i.e. reactor instrumentation and control system, ventilation system, area monitoring system). It has to be updated currently.

International experience is constantly exchanged and updated at meetings. The result of this information exchange is reflected in the overall technical and organisational status of the TRIGA research reactor.

Based on the design requirements the examination plan has to be completed every year and is examined by external experts. The complete report is proved in the written expert opinions, which is discussed, in the annual regulatory interview. It can become an incentive for requirements for the license holder who has to report about the implementation.

It is possible to suspend the operation license until the identified deficiencies are rectified if the regulatory body has serious concerns regarding safety relevant issues. As of the writing of this report, no such events have never occurred since the TRIGA research reactor went critical in 1963.

Article 19 (2) Operational limits and conditions

The SAR includes all operational limits and conditions (OLC) derived from the safety analysis and also including operational experience. Typical OLC's are i.e. excess nominal power, excess fuel or water temperature, short reactor period, any failure of PC components in the I&C system.

In addition, any deviation from the nominal value is announced by an optical and acoustical alarm and thus allowing the operator to start any counteraction before an OLC is reached.

The operating rules contain not only the operating structure, internal regulations governing the operation of the installation, particularly operation of the reactor control, radiation protection, maintenance, fire protection and access control, organisational and safety requirements for the operation of the installation, the procedure for the routine use of the research reactor and the associated facilities, for example, for scientific experiments, operating instructions for all systems critical to safety, but also the safety relevant limits, measures in the case of safety related incidents, criteria for notifiable events and event detection and process description in the case of incidents and the measures to be taken.

Article 19 (3) Procedures for operation, maintenance, inspection and testing

Detailed written procedures for operation, testing, maintenance and re-inspection exist and are regularly updated. These documents are available in electronic form as internal reports. Written procedures exist in the reactor operation manual for responding to operational occurrences and to accidents. Necessary engineering and technical support in safety related

fields are available at the Vienna University of Technology. Besides the in-house workshops business relations have been established with qualified institutions, companies and research institutes to respond to any technical problem which cannot be solved by the in-house facilities.
The annual inspection process by the regulatory authority is further detailed in the BMBWF's Handbook. Specifically, the research reactor must be inspected by the regulatory authority at least once per year according to the legal requirements. This annual inspection is announced. For setting up the annual inspection programme, procedural parameters are kept, including at least one on-the-spot inspection in addition to the one prescribed by the Radiation Protection Act. According to the Radiation Protection Act, for important reasons the authority may carry out inspections at any time.

In addition to the annual inspections, which cover all aspects that need to be controlled (e.g. operational radiation protection, emergency preparedness and response, training and qualification of personnel, etc.), there might be topical inspections, as well as reactive inspections.

Depending on the object of inspection, the methods to be used range from questioning, perusal and examination of the operator's documents/information/test plans all the way to on-the-spot inspections.

The inspection frequencies as prescribed by the law are the minimum values. Thus, for the TRIGA research reactor there should be at least one inspection per year, but in case of planned changes or events that may significantly affect the safety or in case of significant deficiencies in the research reactor operation, there may be more than one inspection in a year.

Two inspectors perform inspections at the Vienna University of Technology, one for the research reactor and one for radiation sources, all holding degrees in technical studies and having experience and training in reactor management. Prior to the inspection, the licensee is obliged to submit a set of documentation listed in the BMBWF's Handbook (including e.g. annual reports on operation, on radiation protection, and on environmental monitoring, Safety Analysis Report, report on training, test results and information on any safety related change in the operation of the research reactor). The authority and its expert(s) review and assess the submitted documents.

In accordance with the General Act on Administrative Procedures and the Radiation Protection Act, the BMBWF may use the services of non-official assessors who conduct checks and inspections to verify the compliance of the authorization holder's activities and to

avert any dangers on behalf of the BMBWF using the appropriate tools. The inspections are performed with participation of the representatives of other involved regulatory authorities (e.g. in fire protection, emergency preparedness or building) and of experts assisting the authority, according to a predetermined agenda set by the BMBWF's handbook. The inspection consists of discussions (oral hearing) with the licensee and observation of documents and activities/operation.

During the inspection, the reports of the license holder are discussed and any measures to be taken are recorded. In the extreme case when the inspection reveals that one of the conditions for granting the license is not complied with and there is a risk to the health or life of humans, the operation shall be prohibited.
The outcome of an inspection is discussed between the inspector (technical expert) and the legal experts of the regular body as basis for enhancement of processes and the planning of topical inspections.
According to the General Radiation Protection Ordinance a Nuclear Safety Officer is responsible for regular inspection of the installation's technical facilities and for the development of improvement and retooling measures on the basis of inspection results, own experience and experience feedback of comparable installations.
The operating organization has to elaborate check-lists for any handling of sources in the development of which it is supported by experts. These schedules have to include all relevant data to document any manipulation with radioactive sources in the regular operation as well as in cases of incidents. Special criteria for information and documentation have to be submitted and are subject to reviews by the regulatory body. Safety relevant deviations have to be reported immediately to the regulatory authority to enable further measures if necessary.
At present there are no regulatory requirements for the operating organization of the research reactor to monitor and control activities performed by contractors, however this is in practice being done by the operation organization even in the absence of a specific legal requirement.

The explicit requirement for the operating organization of the research reactor to monitor and control activities performed by contractors will be included in the revised Radiation Protection Ordinance that will be issued after the new Radiation Protection Act enters into force.

Article 19 (4) Procedures for responding to operational occurrences and accidents

The procedures to be followed in case of operational occurrences and accidents are laid down in the on-site emergency response plan including:

- description of the installation and its equipment with regard to incidents, including an inventory of equipment and its place of storage
- Specifications for the detection and classification of a design basis accident,
- the definition of responsibilities, in particular those of the company's organisation, in the event of accidents,
- Representation of the procedures in the event of incidents, in particular the alarm sequences,
- Summary of reporting obligations to the authorities, including the determination of relevant contact addresses and reporting channels,
- precautions to ensure the reliability of all communication channels,
- agreements with external emergency services and authorities regarding assistance in the event of incidents, in particular with regard to the provision of additional human resources,
- facilities for initial and subsequent radiological impact assessments, including radiological environmental monitoring, and
- protective actions to minimise the exposure of persons to radiation, in particular the establishment of assembly points for workers inside and outside the reactor building, and measures to delimit and label the radiation hazard area and decontamination measures; and
- measures to ensure the medical care of injured persons, in particular their hospitalisation,
- technical measures to prevent the extension of the consequences of design basis accidents, in particular measures to minimise the release and spread of radioactive substances,
- Specifications for the limitation of the dose for the facility's internal personnel,
- regulations regarding public information,
- Regulations for the resumption of normal operation after the end of an accident,
- Measures to preserve evidence,
- Regulations governing staff training and practice,
- arrangements for reviewing and updating the contingency plan.

Article 19 (5) Engineering and technical support

To ensure necessary engineering and technical support in all safety related fields the license holder has to set up and implement a quality assurance system that addresses the above issues. The Austrian law also requires a nuclear safety officer. His tasks include inter alia the development of improvement and retooling measures based on the inspection results, the officer´s operation experience and the exchange of experience with nuclear safety officers of comparable installations. Concerning the technical equipment the license holder has maintenance contracts with the manufacturers of the facility.

Article 19 (6) Reporting of incidents significant to safety

According to the General Radiation Protection Ordinance, the Nuclear Safety Officer shall analyse incidents that are subject to mandatory reporting and other incidents in order to feedback of operating experience. The Ordinance further stipulates the licensee to develop operating rules that shall address, among others, the measures for safety-relevant events,

criteria for reportable events, as well as event detection and process description for accidents and measures to be initiated. Feedback from experience in operating the reactor, taking into account the operational experience for other comparable reactors, is also required to be considered by the periodic safety review.

If there are safety endangering circumstances they have to be reported immediately to the license holder and to the competent authority and the (part of the) facility has to be shut down until the problem could be solved. All these procedures and undertaken measures have to be documented as well.

Depending on the technical problems the regulatory authority may take advice by external experts and impose conditions and requirements for the resumption of the operation.

Article 19 (7) Operational experience feedback

Operational experience is collected and shared among the TRIGA research reactor operators worldwide as well as through the IAEA with the international research reactor community. The Atominstitut of the Vienna University of Technology is member of the

- TRIGA community (meets regularly)
- Arbeitsgemeinschaft Forschungsreaktoren (AFR - meets twice a year)
- Research Reactor Operators Group (RROG - meets once a year) Research Reactor Fuel Management Group (RRFM - meets once a year), International Group on Research Reactor (IGORR - meets every 18 month)
- European Atomic Energy Society (EAES - meets once a year)
- International Nuclear Security Education Network (INSEN – meets annually)

The international experience is constantly exchanged and updated at these meetings. The result of this information exchange is reflected in the overall technical and organisational status of the TRIGA research reactor.

Article 19 (8) Management of spent fuel and radioactive waste on the site

The Vienna University of Technology returned highly enriched fuel elements back to the USA in 2012. Based on a contract between the Vienna University of Technology the US-DoE and

Abbreviations

CNS	Convention on Nuclear Safety
BGBl.	Federal Law Gazette
BWR	Boiling Water Reactor
StrSchG	Radiation Protection Act
AllgStrSchV	General Radiation Protection Ordinance
IAEA	International Atomic Energy Agency
Bq	Becquerel
IRRS	Integrated Regulatory review Service
kW	Kilowatt
MW	Megawatt
EU	European Union
mSv	Millisievert
ÖAW	Austrian Academy of Science
BMBWF	Federal Ministry for Education, Science and Research
BMNT	Federal Ministry for Sustainability and Tourism
BMASGK	Federal Ministry of Labour, Social Affairs, Health and Consumer Protection
SAR	Safety Analyses Report
EPR	Emergency Preparedness and response
HERCA	Heads of the European Radiological Protection Competent Authorities
WENRA	Western European Nuclear Regulators Association
NCA	National Competent Authority
OLC	operational limits and conditions
ALARA	As low as reasonable achievable

Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention); BGBl. III No. 88/2005, entered into force in 2005.

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