Joint Convention
Questions Posted To Germany in 2018

Q.No *	Article Planned Activities	Ref. in National Report K.2, P280
Question/ Comment	According to Chapter K, the site selection of the repository for heat-generating radioactive waste is expected to be finished at the end of 2031. What is the schedule for the license application and approval, the construction and commissioning of the repository? What is the plan for the diposal of high-level waste? According to Chapter K, the German repository would be ready for commissionging at the earliest after 2050, whereas the licenses for the dry storage of spent fuel and high-level waste are valid untill 2034-2047. Under such circustances, how to guarantee the safety of dry storage spent fuel and high-level waste for extral-long period?	
Answer	Regarding the time schedule: According to the Repository Site Selection Act (see §1(5)), the decision on a site for a disposal facility for heat-generating radioactive waste is aspired to be taken by 2031. The national programme envisages commissioning of the disposal facility some time around the year 2050. Germany is aware of the problem of storage for long periods. The storage of radioactive waste is the responsibility of the operator. So far, the operators have not applied for an extended storage yet. Once the operator decides to do so, the licensing process will take place in accordance with the corresponding legal provisions. Please also refer to Chapters G.2.2 and K.3 of the National Report.	

Q.No *	Article Planned Activities	Ref. in National Report Annex K - page 280
Question/ Comment	As indicated several times in the German report, the end of the site selection process for the heat-generating waste is planned for end of 2031 where a site decision will be taken. In the section K, a detailed planning of the site selection process is provided (as suggested during the last review of the report), nevertheless, no information is provided about the expected date for the commissioning of the repository. This assumption is of importance for the management of storage facilities for heat-generating waste to disposed off in this repository. Could Germany provide some assumption about the expected date for the commissioning of the repository for the heat-generating radioactive waste?	
Answer	The national programme envisages commissioning of the disposal facility some time around the year 2050.	

Q.No *	Article Planned Activities	Ref. in National Report 273
Question/ Comment	The report states about affairs regarding challenges of the fifth Review Meeting, and it describes the site selection of the storage of High Level Radioactive Waste in section K.1 (p273) and section K.2. But we do not find the concrete progress for the project. Is there any positive candidate for the Deep Geological Disposal Facility?	

Answer	Following the successful reorganisation of the actors involved (BfE and BGE), the site selection process began in mid-2017. The process is in the very first step of its first phase, as described in the German Report (see Chapter H.3.2 of the German Report for details). Existing geological information from all over Germany is currently being collected and analysed in order to identify regions with potentially favourable geological conditions (i. e. promising deposits of potential host rocks such as claystone, rock salt or crystalline rock). This step is still ongoing. For the time being, there is no further spatial concretisation of such regions.

Q.No	Article	Ref. in National Report
*	Planned Activities	275

Question/ Comment	According to National Report, the license of storage facilities is limited to 40 years. Please elaborate the reason why 40 years limitation is set only for the storage facilities?
Answer	The storage licenses were limited to 40 years to demonstrate the public that the storage is not a permanent solution but a process with a defined end point. By limiting the licensed period for storage facilities to 40 years limits, on the one hand, the storage duration to 40 years from the beginning of emplacement, on the other hand, it also limits the storage of the radioactive inventories in the individual casks to a period of up to 40 years from the date of loading. In case of an extension of the storage period, which is subject to licensing, the license for the storage facility as well as the cask approval has to be extended.

Q.No	Article	Ref. in National Report
*	Planned Activities	K.1, p.275

Question/ Comment	K.1 describes an extension of the storage period of spent fuel until commissioning of the disposal facility. (1) How many years is the renewal period of the storage license? (2) What are the items to be reviewed and inspected by the regulatory body on ageing management and periodic safety review of dry storage facility? (3) Please explain the content of the research projects supported by BMUM, and their goal to achieve and application plan of the results of those projects.

Answer	(1) It has not yet been decided how long the prolongation period will be. It will depend on technical, non-technical and political aspects.
	(2) Main items of a periodic safety review of a dry storage facility are as follows:
	• Up-to-date description of the facility
	• Survey of the safety-relevant changes performed or occurred during the period under review
	  ○ changes in the licensing status: modification licences issued; subsequently imposed licence conditions,
	  ○ changed regulatory requirements,
	  ○ organisational changes,
	  ○ modifications of the storage facility: refitting; repairs and retrofitting, amendment of the regulations on operation, maintenance and

inspection/testing,
    - changes in the operating condition of the storage facility, changes with regard to the emplaced inventory and storage facility occupancy,
    - changes/new findings regarding the site conditions, and
    - interactions with neighbouring facilities and installations.
- Evaluation of operating experience
    - operational management, facility operation, inspection results, maintenance and reliability of components, radiation protection, experience feedback, reportable events, emergency preparedness, ageing management,
    - experiences from information notices, and
    - operating experience in comparable storage facilities.
- Accident analysis
    - existence of other relevant event sequences from experience gained with comparable storage facilities or from updating of rules and regulations,
    - up-to-dateness of safety analysis methods applied,
    - consideration of current boundary conditions and changes in site conditions, as well as
    - measures planned for beyond design basis events.
- Review with regard to technical ageing
- Safety management
    - operational organisation and assignment of powers and responsibilities with regard to the safety-relevant functions of the storage facility,
    - definition and documentation of the safety-relevant processes and the performance indicators, audits, etc. applied for monitoring of the quality of processes,
    - up-to-dateness of the operating instructions and measures for beyond design basis events,
    - measures for maintaining the requisite technical qualification of the operating personnel responsible for storage,
    - measures for ensuring the provision of the necessary resources and competences for normal operation and design basis events, as well as a forward-looking human resources strategy with regard to personnel recruitment, qualification and training,
    - measures for the evaluation of operating experience and for ensuring regular exchange of knowledge and experience between the facility operators, and
    - up-to-dateness and completeness of the management system.
- Long term documentation and electronic data processing

(3) The Project on new developments on long-term storage for spent fuel and vitrified waste will gather information on various aspects for a long-term storage. It describes the current state of technology and presents the national and international situation in this field. It addresses knowledge gaps and effects with long-term relevance which will probably affect the safety of storage during the period of 40 years and beyond.

Not only technical but also non-technical aspects like safety management and ethical issues are considered. Based on the analysis, conclusions are made and recommendations are given to the Ministry for the Environment, Nature Conservation, Building and Nuclear Safety addressing the identified safety issues which could be important for an extension of the storage period.

Q.No	Article	Ref. in National Report
*	Planned Activities	K.1 (1) Challenges

Question/ Comment: From 2019 to 2021, 21 casks are to be returned from the United Kingdom in three transports. Corresponding storage licences and transport permits must be applied for by the electric power utilities (EVU). (p. 275)
For the return of radioactive waste from reprocessing in the United Kingdom after March 2019, has an assessment been made of potential legal or other issues arising as a consequence of the United Kingdom ceasing to be a member of the EU and Euratom?

Answer: The Atomic Energy Act (§ 9a(2a)) stipulates the obligation for electric power utilities to store radioactive waste, which is also laid down in contracts under private law between utilities producing nuclear energy and reprocessing plants. This approach was confirmed by contracts binding under international law between Germany and both France and the UK. There is also consensus between the parties that the waste return will be carried out as soon as possible. For these reasons, no major impacts are expected due to the withdrawal of the United Kingdom from the European Union.

Q.No	Article	Ref. in National Report
*	General	A, 29

Question/ Comment: The NR states about the new Act on the Reorganisation of Responsibility in Nuclear Waste Management: "Thus, the Act secures the financing of decommissioning, dismantling and waste management in the long term without passing on the costs incurred for this purpose unilaterally to society and without jeopardising the economic situation of the operators."
In which extent the revision of the Act was based also on economic evaluations of affected parties?

Answer: The Act on the Reorganisation of the Responsibility in Nuclear Waste Management implements the recommendations of the Commission to Review the Financing for the Phase-out of Nuclear Energy (KFK), that was set up in October 2015. The Commission was tasked to draw up recommendations as to how to organise the financing for the shut-down and dismantling of nuclear power plants and for the management of nuclear waste in such a way that companies will be capable of meeting their long-term obligations under nuclear law. The so called stress test commissioned by the Federal Ministry for Economic Affairs and Energy in 2015 to assess the provisions made in the nuclear-power sector served as a major basis for the Commission’s work.
The audit firm conducted its assessment for the stress test as follows:
In a first step, it examined the estimates used by the energy companies to calculate the expected future costs arising from the individual waste management steps – decommissioning and dismantling of the nuclear power plants, packaging, storage and disposal of the nuclear waste. The assessment was based on information and data provided by the energy companies, including – inter alia – estimates provided by Federal Government Authorities and especially by the Federal Office for Radiation Protection. In a next step, the audit firm escalated these costs (in

prices of 2014) with a basic inflation rate (1.6 %) and an additional inflation rate considering expected cost increases specifically in the nuclear energy sector (1.97 %). Finally, future costs to be borne by the individual NPP operators in order to fulfil their future payment obligations in the nuclear energy sector were discounted with a rate amounting to 4.58 %.
Taking into account the findings of the stress test, the Commission considered possible scenarios for the financing of the nuclear phase-out and their impact on the society and the energy companies. It also conducted consultations with experts who attended individual sessions of the Commission. On 27 April 2016, the Commission presented its unanimous recommendations for action in a report to the Nuclear Energy State Secretaries Committee.

Q.No *	Article	Ref. in National Report
	General	Introduction, P25

Question/ Comment: It is mentioned in the report that the operation license for the cask storage facility at Julich expired on July 30, 2013 and the license for continued operation has not been granted. Is the facility still receiving radioactive waste (spent fuel) currently? Please give more information about the management arrangements of this facility.

Answer: The AVR cask storage facility has only taken in the spent radioactive fuel of the former AVR experimental reactor. No other radioactive waste has been nor will be accepted. Hence, since the last emplacement of a Castor cask holding AVR fuel, there have been no further shipments to this storage facility.

Q.No *	Article	Ref. in National Report
	General	Introduction, P39

Question/ Comment: It is mentioned in the report that inflow of groundwater from the overburden into the mine has been ovserved since 1988…comprehensive stabilization measures are being carried out in the mine workings. Please give more information about the comprehensive stabilization measures carried out including control measures of inflow and groundwater. Please give more information about the arrangements and measures concerning Asse II mine.

Answer: As already mentioned in the report of the Federal Republic of Germany for the sixth review meeting in May 2018, the former mining excavations within the southern flank were already filled with crushed salt earlier on. The air gaps that have formed meanwhile at the roofs of the chambers due to subsidence are gradually being filled with sorel concrete. This is to reduce the overall deformation rate of the mine openings. The objective is to reduce the risk of an enhanced and uncontrollable inflow of water and its consequences. For that reason, mine cavities where no radioactive waste has been stored and that are no longer required are backfilled with sorel concrete. Currently, 70 per cent of the air gaps have been backfilled. This includes all deep excavations below the main emplacement level (i.e. the 750-meter level). Stabilisation measures at the 750-meter level are in progress. The emplacement chambers themselves will only be backfilled with sorel concrete in case an emergency is signalised (e.g. in case of a solution inflow found to be uncontrollable). The backfilling of all unrequired cavities is a laborious process, as numerous preliminary and accompanying jobs need to be carried out, such as the sealing of access points to individual chambers, drilling boreholes for backfilling purposes, and performing control drillings. The deformation rates in the southern flank are measured within

inclinometer boreholes. Several further measuring methods (e.g. seismic measurements) are separately carried out to gain information about changes of the geomechanical situation.
Regarding the saline inflow, there are several areas were the saline solution is constantly observed in terms of rate and chemical composition. The saline solutions enter the salt dome from the adjoining rock at between 500 m and 575 m depth, from where they progress into the mine. The major part of the influent saline solutions is collected on the 658-meter level (additional collecting areas are on the 725-meter level and on the 750-meter level). Contaminated brines at the 750-meter level are not to be confused with the influent saline solutions as they do not originate from influent saline solutions but from the phase of radioactive waste emplacement. The brines collected at the 658-meter level are pumped into an interim reservoir at the 490-meter level and are strictly separated from all other liquids in the mine. These influent saline solutions are removed from the Asse II mine once a month. The saline solutions collected at the 725-meter and 750-meter level are not mixed with other solutions. They remain in the mine and are used internally for the production of sorel concrete.
At the surface, the development of the chemical composition and the level of groundwater is observed in observation wells.

Q.No *	Article General	Ref. in National Report Introduction, Para 4, P40

Question/ Comment: During the technical re-evaluation of Morsleben repository, upon what reasons was believed by the Bfs that Morsleben repository irrevocably waived further emplacement radioactive waste?

Answer: By way of a court order, emplacement in the eastern field of the repository, the only disposal room technically prepared for larger quantities of waste, was temporarily stopped. The further emplacement of radioactive waste could only have been carried out at a higher expense in another disposal area to be newly constructed. The permanent operating licence allowed disposal only until 2005. In addition, the repository did not meet the optimal design requirements of a modern repository due to the use of a former exploitation mine and the resulting technical disadvantages, which lead to increased efforts in decommissioning. The waiver of further disposal of radioactive waste in 2001 is also based on an assessment of the forecast of the low and intermediate level waste volume in the context of the fact that approval of the planned Konrad repository was expected in the near future (2002).

Q.No *	Article General	Ref. in National Report Introduction, Para 3, P41

Question/ Comment: According to the report, the decision on a site for a repository for heat-generating radioactive waste shall be taken by 2031, and wastes are planned to be put into containers and then emplaced in underground galleries and boreholes. What’s the latest development in this regard?

Answer: Following the successful reorganisation of the actors involved (BfE and BGE), the site selection process began in mid-2017. The process is in the very first step of its first phase, as described in the German Report (see Chapter H.3.2 of the German Report for details). Existing geological information and data from all over Germany are currently being collected and analysed in order to identify regions with potentially favourable geological conditions (i.e. promising deposits of potential host rocks such as claystone, rock salt or crystalline rock). This step is still ongoing.

The concept of disposal heat-generating radioactive waste in a suitable deep geologic formation is, as before, unchanged.

Q.No	Article	Ref. in National Report
*	General	L.5, 294

Question/ Comment: Several examples of in-drum drying technology used for treatment of liquids or wet waste are given in the National report. Please specify what is the final form of such waste acceptable for long-term storage or disposal in the repository in accordance with WAC.

Answer: The WAC of the Konrad repository require the waste products to be solid and chemically/biologically stable. For that purpose, liquid waste or wet solid waste products are dried.
The form of the product depends on the waste to be dried, e.g. the product from drying evaporator concentrates is dry salt as granulate or as monolithic block.
The success of the drying is verified by taking samples of the product and determination of the residual moisture or by sampling and analysing the atmosphere of the drum.

Q.No	Article	Ref. in National Report
*	General	Whole report

Question/ Comment: The amount and extent of information provided and the overall quality of the report of Germany are commendable.

Answer: Thank you very much for your comment.

Q.No	Article	Ref. in National Report
*	General	Summary, p.26

Question/ Comment: As it is reported deep geological disposal is intended for all types of radioactive waste, so there is no need to differentiate between short and longer lived radionuclides. Can you please clarify whether and how the concept of clearance (e.g. storage until clearance) is applied in Germany?

Answer: The concept of clearance in Germany is based on the 10 Microsievert concept. In his application for a clearing licence, the licensee has to prove this concept by fulfilling the requirements of § 29 of the Radiation Protection Ordinance or in a case-by-case study.

Q.No	Article	Ref. in National Report
*	General	27

Question/ Comment: Since the Federal Office for the Safety of Nuclear Waste Management (BfE) has established in Germany, what is the biggest achievement of BfE?

Answer: It may be not possible to identify a biggest achievement of a regulatory body. The BfE successfully continues to fulfil the regulatory and supervisory responsibilities of its predecessors. By establishing the BfE, licensing and supervisory responsibilities are now brought together in one single organisation at the federal level. Likewise, the tasks of the operator which were previously distributed over several institutions are

now centralised at one organisation, the BGE.

Q.No *	Article General	Ref. in National Report Introduction Section A.2

Question/ Comment: The report states: “The THTR was in operation between 1983 and 1989 and is in safe enclosure now; the spent fuel is stored in the Ahaus transport cask storage facility”. What kind of methods did you use to condition the RW (dust) which was generated during operation?

Answer: Spent fuel of THTR was filled into canisters which were closely connected to the pipe with a seal. After loading a canister, it was closed with a cap and a seal. Therefore dust can be detected only in a closed canister. After cooling down the canister was put into a cask. During all operations no dust formation was observed.
The THTR is currently in safe enclosure, and graphite dust generated during the operation of the reactor still remains in the reactor vessel. This issue will have to be solved before dismantling of the reactor vessel will start in the future.
During the dismantling process of the Jülich pebble bed experimental reactor AVR, the reactor vessel was backfilled with lightweight aerated concrete for better handling and fixation of the radioactive inventory (i.a. the graphite dust). This might also be a solution for the THTR.

Q.No *	Article General	Ref. in National Report Introduction, p. 41

Question/ Comment: The Report says that “the residues left over from the former uranium ore mining do not count as radioactive waste but, due to the great interest in this issue, details on the related activities are given in a report attached separately.”
Indicated the specific activity of such residues, namely, for alpha-emitting radionuclides?

Answer: The specific activity of the key radionuclide Ra-226 ranges from 0.2 to 1 Bq/g in waste rock material and from 2 to 20 Bq/g in uranium tailings. In waste rock piles, Ra-226 is nearly in radioactive equilibrium with the other long-lived alpha emitters of the U-238 decay chain. In tailings, as a consequence of chemical processing, the uranium nuclides U-238 and U-234 are much less present in comparison to Ra-226. Th-230 and Po-210 are in the same order as Ra-226.

Q.No *	Article General	Ref. in National Report Introduction, p, 33

Question/ Comment: The Report says that “the THTR was in operation between 1983 and 1989 and is in safe enclosure now; the spent fuel is stored in the Ahaus transport cask storage facility.” What are the plans regarding further management of SNF from THTR-300 reactor?

Answer: As a general principle of Germany´s waste management policy, the management of radioactive waste shall as a rule be carried out within German national responsibility. Disposal is to take place on German national territory. This is one of the principles laid down in the national programme according to Council Directive 2011/70/EURATOM (www.bmu.de/en/topics/nuclear-safety-radiological-protection/nuclear-safety/details-nuclear-safety/artikel/national-programme/).
From a legal point of view, in Germany, radioactive waste is to be delivered to a repository (Atomic Energy Act).

Concerning shipments of spent fuel for reprocessing, please also refer to Chapter I.1.3 of the National Report.

Q.No *	Article General	Ref. in National Report General

Question/ Comment: Are there any legal provisions for the treatment of foreign radioactive waste (particularly in case of incineration of RAW)? If any, more detailed information on these provisions would be welcome (e. g. limits and conditions for effluents, the methodology of declaring the activity and nuclide composition of the imported and re-exported RAW, chemical composition of RAW and of the final product, etc.).

Answer: There are no special legal provisions for the treatment of foreign radioactive waste. The provisions for the treatment of domestic radioactive waste also apply to foreign waste. Limits and conditions for discharges with air and water from facilities and installations are laid down e.g. in § 47 of the Radiation Protection Ordinance (StrlSchV). They are expressed as limits of the radiation exposure related to discharges or determined by the competent authority by restricting the concentrations and quantities of activity.
The declaration of the radioactive waste shall be in accordance with Appendix X, Part A and B of the Radiation Protection Ordinance, also containing information on composition of substances and activity of the radionuclides specified by the accepting facility. According to § 73 StrlSchV, the radioactive waste documentation is to be updated upon changes and shall be made available to the person responsible for the waste.
Further provisions for foreign radioactive waste regulate transboundary shipments which require a licence by or has to be notified to the competent authority, the Federal Office for Economic Affairs and Export Control (BAFA). For example, the deliverer shall take precautions that their shipment is only turned over to persons who hold the necessary licence for the handling of radioactive waste. Furthermore, anyone delivering radioactive waste is obliged to obtain an acceptance commitment from the recipient in form of a written declaration prior to delivery.

Q.No *	Article General	Ref. in National Report All document

Question/ Comment: The document is prepared with a high quality. It contains information on:

- inventory of spent fuel and radioactive waste, their location;
- strategies and policies, as well as practices and plans for managing of spent fuel and radioactive waste;
- distribution of responsibility of the involved parties;
- description of key legislative and regulatory documents of Germany on spent fuel and radioactive waste management, as well as recent legislative changes.

The information is structured in accordance with the articles of the Joint Convention and is accompanied by references to relevant articles of national documents. The information is presented clearly and with sufficient level of detail. There are some uncertainties in the text, but this does not reduce the quality of the document.

Answer	Thank you very much for your kind statement.

Q.No	Article	Ref. in National Report
*	General	K 2, p.281

Question/ Comment	Figure K-2 provides for a "licensing" step. It is shown only before the construction of the facility for the disposal of heat-generating waste. Does this mean that only one license is issued for the all steps: construction, operation and closure of the repository?
Answer	With respect to the licensing aspect, the purpose of Figure K-2 is to illustrate that licence application and licensing process will take place after the basic decision on the repository site has been taken by the German Parliament. It is not meant to anticipate details of the licensing process which, indeed, may contain several licensing steps, as stipulated in AtG § 9b.

Q.No	Article	Ref. in National Report
*	General	page 31, Section A

Question/ Comment	The overview table with overview of the German programme for management of radioactive waste with references to the relevant sections of the national report is missing from the report.
Answer	The overview matrix as agreed upon during the Organizational Meeting for the Sixth Review Meeting can be found in Chapter A.3 on page 42.

Q.No	Article	Ref. in National Report
*	General	page 42, A.3

Question/ Comment	What is the schedule for the Spent fuel Disposal Facility given the phase out of Nuclear Plants?
Answer	According to the Repository Site Selection Act, the decision on a site for the disposal facility should be taken by 2031. The decision on a site will be followed by the licensing procedure according to § 9b(1a) of the Atomic Energy Act. The disposal facility for heat-generating radioactive waste is then expected to be operational around 2050 (kindly refer to Chapter K.2).

Q.No	Article	Ref. in National Report
*	General	page 43, A.3 Table A-2

Question/ Comment	Where does the decommissioning waste stored if required? Are there any planned facilities for the disposal of decommissioning waste?
Answer	Until its delivery to a disposal facility, radioactive waste from decommissioning of nuclear power plants has to be stored in storage facilities at the NPP sites or in central storage facilities. The designated disposal facility for waste from decommissioning is the Konrad repository which is licensed and in the process of conversion. The Konrad repository is suitable for all types of radioactive waste with negligible heat generation including decommissioning waste.

Q.No	Article	Ref. in National Report
*	Article 3.1	237-238

Question/ Comment: Is accident analysis done by deterministic methodology only?
Is it included probabilistic methodology?
Could you please provide some examples about interactions or dependency with neighbouring nuclear power plants which you mention?

Answer: Yes, in the licensing procedures for the interim storage facilities, deterministic accident analyses were carried out for the enveloping accidents (e.g. flooding, earthquake, lightning, handling accidents, etc.).
The existing safety equipment and precautionary measures are to ensure compliance with the main safety functions such as

- the safe confinement of radioactive substances
- safe decay heat removal
- criticality safety, and
- the prevention of unnecessary radiation exposure

at all times.

The interactions with the power plant or possibly neighbouring industrial plants were also considered in the licensing procedures for the on-site storage facilities.

According to the ESK guidelines (ESK guidelines for the performance of periodic safety reviews and on technical ageing management for storage facilities for spent fuel and heat-generating radioactive waste of 13.03.14), a review of the deterministic safety status analysis is carried out in the form of a protection-goal-oriented accident analysis, with a description and evaluation of operational management (safety management) and an evaluation of operating experience. The PSR also reappraises the interactions between the power plant or possibly neighbouring industrial plants.

A probabilistic safety analysis is not necessary as passive safety functions have to be provided by the on-site storage facilities.

As regards the interactions of neighbouring nuclear plants, amongst others the effect of an event or accident on the other neighbouring plant is considered. It should still be possible to access individual neighbouring plants even after such events. The same applies to escape routes and the evacuation of personnel.

Q.No	Article	Ref. in National Report
*	Article 3.3	C.3., p55

Question/ Comment: In section C3 you provided information on non-civilian waste: "The treatment and storage of radioactive waste from military or defence programmes remain the responsibility of the armed forces and is not transferred to civil responsibility until the waste is delivered to a repository". Does it mean that civilian repositories should accept military waste? If yes, was the amount of military waste taken into account when the capacity of the civilian repositories was calculated?

Answer: Civilian repositories should accept radioactive waste from the military sector if it complies with the waste acceptance criteria for this repository. The amount of military waste had been taken into account when the capacity of the Konrad repository was calculated. Radioactive wastes from the military sector for the Konrad repository are supply items such as sealed radioactive sources, luminous paints and instrumentations.

Q.No	Article	Ref. in National Report
*	Article 4	G.1

Question/ Comment: Section D.1.3 states that the original storage license period is limited to 20 years for AVR cask storage facility in Julich and Section G.2.2 states that the licences of spent fuel are limited to 40 years for on-site storage facility of Table D-1.
What is reason that license periods for AVR cask and other on-site dry storage are different?

Answer: The licensing period of dry storage facilities was based upon the then envisaged time a disposal site would be available; for the decentralised (on-site) storage facilities, the licensing period is limited in §6 (5) AtG.

Q.No	Article	Ref. in National Report
*	Article 4	G.1

Question/ Comment: Germany has various spent fuel storage facilities such as wet storage outside reactor buildings, on-site storage facility(dry storage), central storage facility(dry storage) and decentralised storage facility(dry storage).
If the separate licensing process is applied to each type of those facilities, please explain the differences.

Answer: The licensing process for dry storage facilities is the same for decentralised (on-site) and off-site storage facilities. The licence application is based on § 6 AtG. The licence of the wet storage facility at the Obrigheim site is based on § 7 AtG. This facility was cleared of spent fuel in 2017. Thus, all remaining external storage facilities of spent fuel in Germany are dry storage facilities.

Q.No	Article	Ref. in National Report
*	Article 4	G.5.3

Question/ Comment: It is stated that BMU has initiated the performance of not only a robustness test for nuclear power plants and research reactors, but also of a stress test for the facilities for the management of spent fuel and radioactive waste in Germany.
Regarding the stress test, what is the difference of considerations taken into for on-site dry storage and wet storage?

Answer Stress tests for the storage pools were carried out within the framework of the stress tests for nuclear power plants by the Reactor Safety Commission (RSK). The decision to perform stress tests for nuclear power plants in the European Union was made by the European Council on 24 March 2011, and the European Nuclear Safety Regulators Group (ENSREG) developed the methodology, the scope and the schedule. One important issue within the stress tests, which covered the nuclear power plants as a whole, was the loss of cooling capability in the spent fuel storage pools.
For the dry storage facilities, stress tests were carried out separately by the Nuclear Waste Management Commission (ESK). The ESK started its work in August 2011 and finished its report in March 2013. The methodology and the objectives here were very similar to those for the storage pools. The important issue here was the robustness of the facilities against impacts that go beyond the design requirements as e.g. earthquakes, flooding, heavy rain and other weather-related events, loss of electrical power, internal and external fires as well as aircraft crashes and blast waves.
In both studies, the German licensees reported no shortfalls regarding safety precautions for their facilities. Likewise, no cliff edge effects were detected. The German regulatory body confirmed this finding as far as the licensing basis and the basic safety design was concerned.

Q.No	Article	Ref. in National Report
*	Article 4	G.1.4, p.193

Question/ Comment Section G.1.4 mentions that realistic plans are annually submitted showing that adequate storage facilities are legally and technically available to meet concrete requirements for the next two years in order to prove adequate provisions exist for reuse of disposal or SNF to the supervisory authority.
Is there any reason to set 'two years;' as the period of meeting requirements?

Answer With the amendment of the Atomic Energy Act in 2002, the operators are required to store spent fuel and the radioactive waste from reprocessing in the on-site storage facilities. This requirement is based on the polluter pays principle, which means that proof is to be furnished that adequate precautions have been taken for the safe storage of already existing and for future spent fuel as well as for the waste to be returned from reprocessing in storage facilities until such time as it is transferred to a facility for disposal. With the 2002-amendment, the timeframe for the realistic projection of the expected need for storage capacity has been shortened from six to two years in consequence of the erection of on-site storage facilities at the (then) operational reactor sites and the loss of other options (reprocessing ban). Now, the legal and technical availability of storage capacity as needed is to be demonstrated for the following two years on the basis of realistic projections.

Q.No	Article	Ref. in National Report
*	Article 4	Section G1.4 p.193

Question/ Comment Section G1.4 describes the requirement for the licensee to prove to the supervisory authority that adequate provisions exist for the reuse or disposal of spent fuel through realistic annual plans.

Please explain the process for assessing this and what degree of evidence is required by the supervisory authority to provide sufficient

confidence that adequate capacity exists including contingency for disruptions to plans.

Answer Realistic projection means the description of the total fuel cycle showing also the amount of spent fuel accruing at each reactor. Regarding the storage requirements for already existing and for future spent fuel as well as for the waste to be returned from reprocessing, proof must be furnished that storage facilities are both legally and technically available for the following two years on the basis of realistic projections. Similarly, realistic projections shall be submitted to the supervisory authority for the production of MOX fuel and its use, and for the safe storage of uranium extracted from reprocessing showing adequate storage facilities according to the requirements as well as the measures required to implement these projections within the next two years. The projections are verified via the submission of contracts or via corresponding confirmations from third parties having suitable facilities for such purposes.
These proofs and projections must be updated annually and submitted to the supervisory authority. The projections in connection with the actually stored amounts can reveal shortages for storage. With the annual reporting obligation major changes can be captured.

Q.No	Article	Ref. in National Report
*	Article 4	Section G2.2 p.196

Question/ Comment Section G2.2 states that Germany's strategy is to store fuel in its existing facilities until the future repository is completed and identifies that the existing storage periods are not sufficient. This means that either relicensing of the existing stores or construction of new stores will be necessary. The report goes on to describe the process Germany is taking to investigate extending the current licensed storage periods and acknowledges the interdependencies between the storage period required and the availability of the disposal facility.

How are these interdependencies being incorporated into the future licensing and regulation of these facilities and how does this align with the periodic safety review requirement for the use of "state of the art science and technology"? How is the risk being assessed across these facilities?

Answer An extension of the storage period is subject to licensing. According to § 6(5) of the Atomic Energy Act, licences for storage facilities may only be renewed on imperative grounds and after prior referral to the German Bundestag. The Commission on the Storage of High-Level Radioactive Waste has recognised that there are interdependencies between the storage period required and the availability of the disposal facility that have to be taken into account in the licensing processes for storage and disposal facilities. Despite the issues that could arise in connection with an extension of the storage licences, like long-term and ageing effects as well as public acceptance, the fundamental principle of maximum safety for the repository must not be compromised.
During storage, the inventories of the casks must remain in a condition allowing for safe storage, handling, transport, and unloading. Furthermore, the removal of the fuel from the storage facilities must be synchronised with the necessary conditioning according to the disposal concept.
Regarding these issues, the Commission recommended a periodic review of the current storage concept focusing on the following aspects: necessary measures to ensure the safe storage of spent fuel and heat-generating waste until the removal of the last cask, ensuring the

transportability of the casks as a prerequisite for granting a transportation licence, a professional ageing management, periodic randomised checks of the inventory condition, the possibility of repairs and repackaging actions in central or decentralised facilities as well as know-how maintenance. These issues must be considered within the future licensing and regulation of storage and disposal facilities.
As long as the storage facilities are in operation, periodic safety reviews are required. When an extension of the storage period is applied for, which is subject to licensing, it has to be proven that the state of the art in science and technology is applied to prevent damage, according to § 6 of the Atomic Energy Act.
Risk assessments both for storage facilities and disposal facilities are based on the statutory provisions laid down in the existing regulatory framework.

Q.No	Article	Ref. in National Report
*	Article 5	page 195

Question/ Comment: It is stated that the possibility to recover the casks for 500 years after the closure of the facility must exist. In practice, what does the possibility to recover the casks mean and what impact does this have on the final sealing of a repository?

Answer: Recoverability over a period of 500 years is a requirement posed primarily on the waste container, meaning that its integrity and manageability must prevail for at least this period of time. The repository itself is thought to be closed and backfilled after emplacement of the last waste container. Thus, immediate sealing of the repository is not affected by the technical ability to recover waste containers. Recovery is not intended, but the ability to do so in case of a future necessity has to be shown.

Q.No	Article	Ref. in National Report
*	Article 5	Summary, p22

Question/ Comment: "According to § 6(5) AtG, the licences may only be renewed on imperative grounds and after this issue has been discussed in the German Bundestag." Concerning the renewal issue it is not clear what the role of the Bundestag is. Does the decision on the renewal need the approval of the Bundestag?

Answer: The existing licences of the on-site storage facilities in Germany will expire from 2042 on after 40 years of storage. As long as there is no repository, there is a duty to store the spent fuel elements in storage facilities according to § 9a(2)3 Atomic Energy Act. Before a renewal of these storage licences by the competent authority BfE, the legally not binding discussion in the Bundestag may then be of principle character or will take place for each single storage facility.

Q.No	Article	Ref. in National Report
*	Article 5	Summary, p22

Question/ Comment: "It was demonstrated and confirmed in the licensing procedure that the casks are suitable for at least 40 years of storage. Thus, the licences currently limit the storage period to 40 years, starting with the emplacement of the first cask." Could you describe how you investigate the compliance of the measured parameters and the documented criteria set by the authority in this license?

Answer	In accordance with the storage licences, the competent nuclear supervisory authorities carry out accompanying in-process inspections to verify compliance with the quality requirements for the casks. In addition, before a cask is loaded, proof has to be furnished of QA measures that have been carried out during manufacture and certificates of completed in-service inspections have to be presented.

Q.No	Article	Ref. in National Report
*	Article 5	G.2.2, p.196

Question/ Comment	According to the G.2.2, the storage of spent fuel is not considered to be a single and independent step, but only a part of the entire waste management process; this is because there is interdependency between storage and other waste management steps (conditioning and disposal) as well as transportation. In Germany, dual purpose casks for transport and storage are widely used. Is there any alternative inspection requirements when dual purpose cask can't meet the transport cask inspection requirement when being used as storage cask?
Answer	The German guidelines for dry cask storage of spent fuel and heat generating waste contain the requirement that, as far as any in-service inspections have to be performed within the framework of quality assurance measures during normal specified operation, the conception and the design of the facilities is to be such that the area to be inspected can be accessed unhindered and the inspections can be performed with low radiation exposure of the personnel. There is no need for alternative inspection requirements.

Q.No	Article	Ref. in National Report
*	Article 5	G.2.2, p.196

Question/ Comment	According to the G.2.2, the Nuclear Waste Management Commission (ESK) has published a discussion paper where they expect storage periods of up to 100 years. In view of public acceptance, interim storage for 100 years can be regarded as imputing the burden of this generation to the next generation. (1) How could ESK overcome this concern? (2) How did the public react when ESK published the paper where they expect storage periods of up to 100 years?
Answer	1) You will find the discussion paper with the following link: http://www.entsorgungskommission.de/sites/default/files/reports/eskdiskussionspapiervzl29102015homepageen.pdf In chapter 5 it is stated: “Intergenerational justice The responsibility towards future generations is also referred to as intergenerational justice. By this is meant that the generation that benefits or has benefitted from a technology also bears the associated burden and, as far as possible, should not leave costly and extraordinarily binding tasks to the following generations. In the context of the use of nuclear energy, this means that the issue of waste management will be solved as soon as possible and without requiring active measures in the future. In this respect, the term “as soon as possible” is to be understood as without major delay. For the licensing of on-site storage facilities for spent fuel, this aspect was taken into account by limiting the durations of

licences for storage to 40 years until delivery to a disposal facility, which, at that time, were considered to be sufficient.

Already with today's time perspectives, the administrative, financial and social responsibility and the practical implementation of waste management tasks are, in substantial parts, transferred to the following generations.

Would this period additionally be expanded by further delays in the site selection process until commissioning of a disposal facility and the resulting extended storage, further tasks would be transferred to generations of the even more distant future. The decision-making independence, resulting from the deferment of the issue of disposal to future generations, regarding the further use or disposal of the waste, taking into account any further developed technologies, is thus to be weighed against the obligations to ensure the safe operation of interim solutions against the background of unforeseeable socio-political developments and risks."

(2) Not only since publishing of the discussion paper, the public and especially the public at the storage facilities sites was informed about the necessity to extend the storage period to ensure a safe construction and commissioning of a disposal facility in deep geological formations. Therefore, this aspect was not the cause for editing of the discussion paper.
The extension of the licensed storage periods, which will become necessary in Germany in the near future in view of this situation, involves a number of safety issues that were not to be dealt with within the framework of the licensing procedures so far.
In the discussion paper, the ESK addresses technical and licensing requirements as well as economic and ethical aspects that result from the safety aspects of an inevitably extended storage in Germany.

Q.No	Article	Ref. in National Report
*	Article 5	Subsection G.2.2, pag 196

Question/ Comment: it is mentioned that the storage of spent fuel and high level vitrified waste in casks is already being practiced for decades in Germany, and the licences for the storage of spent fuel and heat-generating waste are limited to 40 years. Could you explain if this term is also applicable to the dry casks?.

Answer: After being discharged from the reactor, spent fuel is stored in pools at the reactor sites for several years for cooling until it meets the conditions for dry cask storage. The subsequent storage of spent fuel and of the vitrified high level waste is done exclusively in dry dual purpose casks. The storage period in dry storage facilities is limited to 40 years. This limits the licences of the storage facilities to 40 years starting from the emplacement of the first cask as well as the cask approvals to a period of up to 40 years from the date of loading.

Q.No	Article	Ref. in National Report
*	Article 5	G 2.2, p.196

Question/ Comment: It is impossible to guarantee, based on the current knowledge, that all the fuel will be retrieved from the storage facilities during the 40-years' licensed period.
Were there any theoretical or experimental studies of the condition of spent fuel and materials of storage casks in SF dry storage facility, including the beyond the design life storage period (more than 40 years), carried out? Is there any design basis justification to confirm robustness of the fuel geometry available?

Answer: The licence limitation of dry dual purpose casks to 40 years has no technical reasons. However, the conditions of casks, materials and inventories are subject to national and international research programmes. Hence, there are theoretical and experimental studies on the conditions of spent fuel and materials of storage casks going on, also in Germany. First investigations were related to the long-term behaviour of the metallic seals. Currently, spent fuel rods are tested for their transport behaviour under normal and accident conditions. Furthermore, theoretical thermo-mechanical simulations of beyond design life storage periods are carried out, aiming at a better understanding of the spent fuel behaviour under the influence of material alteration effects.

Q.No	Article	Ref. in National Report
*	Article 6	D3.3, G3, G4, G5

Question/ Comment: It seems that only the classic repository concept has been considered for the disposal of radioactive waste. However, the borehole concept is seriously envisaged by some countries and it may have some advantages compare to the classic repository concept. Has the borehole concept been studied? If appropriate, what were the conclusions? Is the borehole concept still envisaged for the future or has it been ruled out?

Answer: Disposal of High Active Waste in deep boreholes has been assessed by the "Commission on the Storage of High-Level Radioactive Waste", together with a variety of other disposal options. Most of them have been ruled out for various reasons. Deep borehole disposal has, in contrast, been earmarked as being principally worth further observation of future developments. But, considering the fact that no in-depth studies or demonstration projects have been conducted so far worldwide, the technology for deep borehole disposal is regarded as being less mature compared to proven mining technologies that can be applied when realizing a "classic" repository concept. Furthermore, a number of unsolved technical problems have been identified, like the obligatory use of borehole fluids under corrosion and gas generation perspectives, sufficient borehole diameters in great depths, as well as its suitability for larger amounts of waste and under given requirements of retrievability and recoverability. Thus, a fundamental uncertainty exists about whether it will be possible to actually demonstrate that deep boreholes reliably represent an option for safe disposal. The site selection procedure for disposal in an underground facility must therefore not be restricted while waiting for further development of the deep borehole concept. Nevertheless, deep borehole disposal may be reconsidered in future if significant progress takes place.
For further information you may refer to Part B, chapter 5.4.3 "Deep borehole disposal" in the final report of the "Commission on the Storage of High-Level Radioactive Waste", an English translation of which is available via BMU:

www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Endlagerprojekte/bericht_kommissionn_lagerung_radioaktiver_abfallstoffe_bf.pdf
The research programme of the Federal Ministry of Economic Affairs and Energy includes the research of alternative solutions to final disposal concepts in a mine. In this context, a study is currently underway, which considers the disposal in deep boreholes. A report on this research project will be published at the end of 2018.

Q.No	Article	Ref. in National Report
*	Article 6	G1.5, G3, G4, G5, D3.4

Question/ Comment: It is usually recommended in the site selection process not to select, as much as possible, a site that may contain possible natural resources (for instance salt). The objective is to limit the attractiveness of the site to reduce as much as possible the probability of intrusion in the future. May you please explain how this constraint has been taken into account during the site selection process?

Answer: This is taken into account in the Repository Site Selection Act. One criterion – as laid down in § 25 StandAG (Appendix 12) – is the presence of natural resources and possibilities of their use. Sites with no natural resources are preferred, if they offer the same level of suitability with regard to the criteria of higher priority, such as favourable chemical and mechanical properties of the host rock.

Q.No	Article	Ref. in National Report
*	Article 6	G.3.3, p.201

Question/ Comment: According to the G.2.2, the public hearing is intended to provide those who have raised objections during the period determined by § 7 AtVfV with the opportunity to explain their objections. According to § 12(1) AtVfV, the public hearing is not open to the general public.
(1) What made the pulic hearing, mentioned above, stipulated in § 12(1) AtVfV?
(2) Why isn't the public hearing open to the general public?

Answer: (1) The hearing is part of the approval procedure and thus also serves as a basis for the review of the application by the licensing authority:
„The purpose of the hearing shall be the discussion of the objections submitted in time, insofar as such discussion may be of importance for the examination of the approval prerequisites.
It is intended to provide those who have raised objections with an opportunity to further explain their objections" (§ 8(2) AtVfV).

(2) During the disclosure of the application and documents for public inspection objections may be submitted.
Those who raised objections in time are allowed to be present at the hearing.
The hearing is neither an information event for the persons concerned nor a trial at the end of which a decision is made. Instead, it is the beginning of the technical and legal review of the application by the licensing authority.
By making the hearing non-public, the participants shall be allowed to participate on an undisturbed basis.
However, the chairman has the right to make special exceptions in favour of the public, provided that this does not affect the impartiality of the participants' comments.

Q.No	Article	Ref. in National Report
*	Article 6	Section H3.2 p.228

Question/ Comment: The report talks about three phases for site selection of a Geological Disposal Facility and mentions geological weighing criteria in phase one and exclusion criteria in phase 2.

The report provides very little information on the criteria.

Please provide further details of the above criteria, their development and the process of public engagement for siting.

To note, this also relates to Article 13.

Answer: The criteria are stipulated in the Repository Site Selection Act. The site selection procedure is primarily based on safety-related criteria as follows:

Exclusion Criteria, indicating that a region or site is unsuitable for disposal, include thresholds or information on

- large-scale vertical crustal movements (uplift)
- active fault zones
- influences from current or previous mining activities
- seismic activity
- volcanic activity
- groundwater age

Minimum Requirements which are obligatorily, include thresholds or information on

- maximal hydraulic permeability of host rock formation
- minimum thickness of the containment-providing rock zone
- minimum depth of the containment-providing rock zone
- sufficient areal footprint of the containment-providing rock zone
- preservation of the geological barriers over one million years

Weighing or consideration criteria, to be used to compare and rank potentially suitable sites, include the comparison of site-specific information concerning:

- Low transport of radioactive substances via groundwater movement and diffusion in the containment-providing rock zone
- Favourable configuration of rock formation, particularly of host rock and the containment-providing rock zone
- Good spatial characterisability
- Good predictability of long-term stability of the favourable conditions (for at least one million years)

- Favourable rock-mechanical preconditions
- Low tendency to the formation of water flow paths in the containment-providing rock zone
- Good conditions to prevent or minimise gas formation from waste under disposal conditions
- Good temperature tolerance of the host rock when receiving thermal energy from the high active waste
- High radionuclide retention capacity of the rocks within the containment-providing rock zone
- Favourable hydrochemical conditions
- Protective structure of the overburden

Supplemental but subordinate to the safety-related criteria, planning criteria are to be applied to compare sites that are considered being equal from a safety perspective. These planning criteria include aspects of general health protection, protection of unique cultural or natural heritage, or locally competing uses and infrastructure.
For a detailed description of the criteria and their development as well as processes, measures and actors of public participation, the report of the "Commission on the Storage of High-Level Radioactive Waste" may also be referred to, an English translation of which is available via the BMU:
www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Endlagerprojekte/bericht_kommissionn_lagerung_radioaktiver_abfallstoffe_bf.pdf

Q.No	Article	Ref. in National Report
*	Article 8	G.5.1, p.208

Question/ Comment: It is said that according to the guidelines, external natural impacts and man-made impacts from outside are taken into consideration in the design of dry storage facility.
(1) please explain the management and processing method of liquid radioactive waste occuring due to fire suppression in the event of fire accident.
(2) If dry storage building collapses due to man-made impacts such as an aircraft collision, storage casks might be tip-over and the intergrity of spent fuel might be affected. What measures are you considering in the event of such accidents?

Answer: The tightness of the transport and storage casks would also be ensured in case of postulated impacts (beyond-design-basis) by fire.
In case of a fire accident in a storage facility for low- and intermediate level waste, extinguishing agents (e.g. water, foam) may become contaminated by radioactive substances. If these contaminated liquids cannot be cleared they have to be considered as radioactive waste. Liquid radioactive waste in Germany is typically primarily dried, cemented or vitrified as conditioning method, also depending on the radiological properties of the waste.
The design requirements were considered in the licensing procedure for storage facilities. Thus, fulfilment of the main safety functions by the transport and storage casks is ensured even in the case of beyond design events. A release of radionuclides where the reference levels for the initiation of major disaster control measures would be reached can neither occur with the mechanical loads on the casks nor in case of a subsequent kerosene fire.

In Germany technical and personnel precautions are in place to stabilize a nuclear installation following an accident, to analyse the cause and to eliminate the resultant effects. This emergency programme includes i.a. radiation measurements, radiation protection monitoring of personnel, recovering of radioactive material, using remote-controlled manipulator vehicles, decontamination of personnel, equipment and enclosed areas, or filtering air.

Q.No	Article	Ref. in National Report
*	Article 8	G.5.1, p.208

Question/ Comment: It is stated that man-made impacts from aircraft crashes are one of what are taken into consideration for accident analysis in page 208 of national report.
(1) Are the intended aircraft crashes inlcuded in the evaluation requirement?
(2) Is there any regulatory criteria for the intended aircraft crashes?

Answer: Aircraft crashes are included in the evaluation requirements. The "intended aircraft crash" scenario does not belong - according to assessment of the federal and Länder nuclear licensing and supervisory authorities in agreement with the German security authorities - to the load assumptions of postulated scenarios (Design Basis Threat) for the nuclear security of nuclear installations and facilities. The authorities also held this technical assessment in the light of the attacks of 11 September 2001. Nevertheless, for the “intended aircraft crash” scenario as a kind of “design extension condition” mitigation measures to minimize the radiation exposure have to be in place within the framework of the integrated security and protection system. The Federal Office for the Safety of Nuclear Waste Management includes intended aircraft crashes in security considerations in licensing procedures for storage facilities.

Q.No	Article	Ref. in National Report
*	Article 8	Subsection G.5.3 page 210

Question/ Comment: Referring to the storage of the spent fuel, in this section it is mentioned that the design of the containers furthermore ensures that, even in the event of a beyond design basis accident, no major disaster control measures are required. Which are the beyond design basis accident considered?. Are external events like prolonged flooding of the facilities or a tidal wave analized?. Are also included in the analysis man indiced actions?.

Answer: Beyond design basis accidents are external impacts which are not design-determining in terms of § 49 StrlSchV (Radiation Protection Ordinance) due to their low occurrence probability. According to the guidelines for dry cask storage of spent fuel and heat generating waste, however, protection measures are to be taken against the events “aircraft crash” and “external blast wave” in order to reduce the harmful consequences of such an event. Both events have a very low occurrence probability of less than 10-6 per year.
Analyses showed that in the case of a crash of a fast-flying military plane on the storage building, the resulting doses will be significantly below 1 mSv. This means that no emergency measures will be necessary and the requirements of the above-mentioned guidelines are met. The requirement of § 6 StrlSchV to minimise the radiological consequences is thus also taken into account.
In case of a blast wave resulting from a chemical explosion, even the accident planning levels of § 49 StrlSchV are undercut. Protection against

radioactive releases is ensured by the storage casks. Analyses showed that the radiological consequences of activity releases are the same or below the results regarding aircraft crashes.
Furthermore, the robustness of the facilities against e.g. earthquakes, flooding, heavy rain and other weather-related events, loss of electrical power as well as internal and external fires was assessed in the framework of post-Fukushima stress tests of dry storage facilities.

Q.No *	Article	Ref. in National Report
	Article 8	G 5

Question/ Comment	Are sub-criticality calculations for design accidents planned? What value of Keff will be adopted for such accidents? "
Answer	For design basis accidents, criticality safety shall be demonstrated, usually based on a Keff of 0.95.

Q.No *	Article	Ref. in National Report
	Article 9	G.6.2, 211-212

Question/ Comment	Provide details on established OLSs for SF facilities – are they required by legal documents (e.g. as a part of safety case supporting the license application), what is their structure and how they are controlled?
Answer	OLCs (Operational Limits and Conditions) for SF facilities are defined at different levels of the legislative framework in Germany. General aspects, like the prevention of radiation exposure or contamination of persons and the environment, are laid down in the Atomic Energy Act and the Radiation Protection Ordinance and are further specified in guidelines and recommendations of the advisory bodies, KTA safety standards and operating manuals. Further OLCs may be derived from the protection goals and e.g. for dry storage facilities they are established in the guidelines for dry cask storage of spent fuel and heat-generating waste of the Nuclear Waste Management Commission. Boundary conditions for cask properties, on the other hand, are compiled in the form of technical acceptance criteria. OLCs are part of the licensing process and of supervisory measures. The procedures to control the OLCs are defined in the operating manuals and include measures like recurrent inspections and monitoring of operations. OLCs are also part of the safety documentation, which serves as a reference for the safety assessment of modifications in the storage facility and operating practice. OLCs are further developed and updated upon modifications of facilities and procedures, new regulatory requirements and relevant standards, by analysing operating experiences, periodic and regular safety reviews as well as evaluating events. Part of the supervision by the competent authority is to assure correct controls of OLCs, e.g. by reviewing records as well as by inspection of facilities.

Q.No	Article	Ref. in National Report
*	Article 9	G.6.5 and H.6.6

Question/ Comment: Could you please provide short description of the incident reporting criteria for categories S,E,N,V or provide reference to the relevant regulation in English if available? Could you, please, also provide statistic data on events in radioactive waste management facilities during 2014-2016, reported to the BMUB and BfE? Could you give several examples of such events?

Answer: The reporting criteria for categories S, E, N and V are as follows.

Category S (Immediate report – deadline: immediately)

Events have to be allocated to Category S that have to be reported immediately to the supervisory authority to enable the latter to initiate or order measures at very short notice if necessary. This also includes events that indicate acute safety deficiencies. Reports of Category S have to be made immediately by telephone or in written form by communications facilities; after no longer than five days following first knowledge about the event, any supplement to or, if necessary, correction of the report has to be submitted on a special reporting form.

Category E (Urgent report – deadline: within 24 hours)

Events have to be allocated to Category E that do not require any immediate action by the supervisory authority but whose cause has to be clarified quickly and, if necessary, rectified within an appropriate period of time for reasons of safety. These are usually events of potential – but not acute – safety significance. Reports of category E have to be made after no longer than 24 hours following the event at the latest by telephone or in written form by communications facilities; after no longer than five days following first knowledge about the event, any supplement to or, if necessary, correction of the report has to be submitted on a special reporting form.

Category N (Normal report – deadline: within five working days by means of reporting form)

Events have to be allocated to Category N that are of little safety significance. They diverge only to a minor extent from the routine operational events of the normal specified plant state and operation. They are evaluated in order to find possible weaknesses before any major disturbances can occur.

Category V (Prior to commissioning – deadline: within ten working days by means of reporting form)

Events have to be allocated to Category V that occur prior to the commissioning of the facility and about which the supervisory authority has to be informed with a view to the later safe operation of the facility.

Further reporting criteria for the supply and disposal of nuclear fuel, may be found in Appendix 2 of the “Ordinance on the Nuclear Safety Officer and the Reporting of Incidents and other Events” (www.bfe.bund.de/SharedDocs/Downloads/BfE/EN/hns/a1-english/A1-10-10.html)

Events in radioactive waste management facilities during 2014-2016 as reported to the BMU and BfE are listed in the Table below.

Events total in 2014: 9

- On-site storage facilities: 1
- Karlsruhe reprocessing plant (WAK), Advanced Nuclear Fuels GmbH at Lingen (ANF), Uranium enrichment plant at Gronau (UAG): 8
- Reporting criteria: all category N

- INES: all INES 0

Events total in 2015: 8

- On-site storage facilities: 6
- Karlsruhe reprocessing plant (WAK), Advanced Nuclear Fuels GmbH at Lingen (ANF), Uranium enrichment plant at Gronau (UAG): 2
- Reporting criteria: all category N
- INES: all INES 0

Events total in 2016: 9

- On-site storage facilities: 1
- Karlsruhe reprocessing plant (WAK), Advanced Nuclear Fuels GmbH at Lingen (ANF), Uranium enrichment plant at Gronau (UAG): 8
- Reporting criteria: all category N
- INES: all INES 0

As an example, an event reported from the on-site storage facility in Brunsbüttel is summarised, which took place on 16 December 2016. During handling of a transport and storage cask in the storage facility, motor protection of the main hoist of the storage hall crane was triggered when erecting a cask on the heavy duty trailer. After checking the situation and acknowledging the error, motor protection system was triggered again during further operations. This error could also be acknowledged. Already on 4 December 2016, triggering of motor protection and of the standstill control of the trolley drive occurred once.
Consequence: The operational handling process was temporarily interrupted. Safety-relevant impacts had not to be expected.
Cause: The cause has not yet been conclusively determined. The manufacturer of the crane system assumes an electromagnetic incompatibility (EMI) to be the cause.
Precautions to be taken: After clarification of the cause, an examination is made to find out whether the affected circuit breaker has to be replaced.

Q.No	Article	Ref. in National Report
*	Article 11	Section D4.3 p.80

Question/ Comment: In Section D4.3, Page 80 there is a sentence about the occurrence of explosive gases in the ASSEII mine stating that: “The Occurence of Explosive Gases is far below the explosion limit so far, the radiological findings are in the expected range”

It is not clear from the report what the source of the gases is and what strategies are in place to mitigate the risk of their occurrence.

Please provide details of the gases occurring and the strategy for their management.

Answer	The development of explosive gas is possible due to corrosion of the metal components of the radioactive waste after contact with water. Further possibilities are degradation of organic material in the waste and radiolysis. Because of influent saline solution, it is not possible to prevent the contact with water to stop these processes. A strategy to prevent gas development after closure is to remove any part of metal or organic material no more in use during the operating phase of the mine. Investigations on the occurrence of explosive gases are part of the specific exploration of each sealed chamber immediately before starting retrieval. Measures for the management of explosive gas during retrieval depend on the results of the specific exploration.

Q.No	Article	Ref. in National Report
*	Article 12	H, 222

Question/ Comment	4. Lander is presently responsible for licensing Konrad and ERAM repositories until transferred to BFE. Lander is also responsible for licensing and supervising other RWF Is Lander presently a promoter (as operator of Land collecting facilities) and a Regulator as well (Licensing and supervision of other RWF)?
Answer	The Länder have established Land collecting facilities for the storage of the radioactive waste originating on their territories in accordance with § 9a (3) Atomic Energy Act (AtG). To fulfil their obligations, the Länder may avail themselves of the services of third parties. The Radiation Protection Ordinance (StrlSchV) regulates what kind of radioactive waste is to be delivered to the Land collecting facilities and to the federal installations like Konrad. Regarding low and intermediate level radioactive waste, the Länder are responsible for licensing and supervising storage facilities and predisposal radioactive waste treatment facilities.

Q.No	Article	Ref. in National Report
*	Article 12	H.2

Question/ Comment	What technical solutions (types of waste containers, their wall thickness, contents and characteristics of barrier materials and etc.) are being used during RW management to decrease the impact of intensive degradation of barrier materials caused by increased heat output on RW safe storage and disposal? How the adequacy of these solutions is being demonstrated?
Answer	In the Federal Republic of Germany, waste has been subdivided into heat-generating waste and waste with negligible heat generation in order to meet the requirements concerning the registration and categorisation of radioactive waste from the point of view of disposal. All types of solid or solidified radioactive waste with negligible heat generation are intended for disposal in the Konrad repository. The results of the safety assessment, as far as applicable, have been transposed into quantitative waste acceptance requirements including activity limitations for individual radionuclides as well as maximum emplaceable activities, maximum masses of harmful non-radioactive waste package constituents. The waste acceptance requirements to be met by the waste packages consider the normal operation of the repository, incidents and the post-operational phase and do not only refer to the type of packaging and the permissible activity inventory of the waste package, but also to the nature of the waste product. All waste containers belong to standardised basic types, which meet the basic requirements such as e.g. stackability and a specific density. The containers are categorised in four container classes: Class I with minor requirements, Class II with

higher requirements, and incident-proof containers of the two classes I and II, respectively. Containers of Class I have to preserve their integrity during an impact of 5 m/s and a subsequent fire at 800 °C for an hour. As for containers of Class II, the total leakage rate of 10^{-4} Pa m^3/s shall not be exceeded and the gas release shall not exceed 1 mol after a fire at 800 °C for an hour and a cooling phase of 24 hours. As for incident-proof containers of Class I, the radioactive waste itself has to be stable in shape or the waste has be packed into containers as 200 l drums which are then cast in a dimensionally stable manner. The shape stability or the integrity of the internal containers has to be preserved after a drop from a height of 5 m. The waste product must be covered all-sided by a non-active layer with a thermal resistance of at least 0.1 $m^2 \cdot K/W$. As for incident-proof containers of class II, the shape stability or the integrity of their internal containers has to be preserved after a 5-m drop, the total leakage rate of 10^{-4} Pa m^3/s shall not be exceeded. In addition, the wall of the container has to possess a thermal resistance of at least 0.1 $m^2 \cdot K/W$ up to an impact of 5 m/s and a release of radioactive materials is not allowed after a fire at 800 °C for an hour and a cooling phase of 24 hours. The conditioned waste products are divided into six waste groups (bitumen and plastics; solid materials; metals; compacted products; cemented/concreted waste; concentrates according to their form/nature and not only depending on their activity. There are 11 standardised basic types of which 5 are cylindrical and 6 square-shaped. Two of the cylindrical ones are made of concrete, the other 3 of cast iron. The square steel sheet containers can include an inner box made of concrete with different density and thickness suitable for different shielding requirements. Similarly, the cylindrical MOSAIK® II-15-cask can be adapted to different activities of the inventory by adding a lead shielding. Furthermore, the so-called Konrad-containers may be subjected to decay storage within a secondary shielding.
That the waste package is suitable and that the requirements are fulfilled needs to be verified during the type testing. During the quality control, the adequacy of the waste package for the specific waste is verified.

Q.No	Article	Ref. in National Report
*	Article 12	H.2

Question/ Comment: As far as we know, quite large amount of irradiated nuclear graphite form research and prototype reactors operation exists in Germany. However, the ways of addressing the issues associated with the management of reactor graphite have been not discussed in the report. Please, indicate what approaches are currently being considered to address these issues?

Answer: Insofar as irradiated graphite from the trial and prototype reactor in Germany is to be disposed of, disposal in the repository for heat-generating waste to be set up according to the Repository Site Selection Act is planned for this purpose. In determining the waste acceptance criteria for the repository according to the Repository Site Selection Act, the geological characteristics of the site and the disposal concept foreseen there must be taken as a basis. This is not possible at the moment. In this respect, no further details can be provided on any necessary conditioning measures for existing waste.

Q.No *	Article	Ref. in National Report
	Article 13	page 228

Question/ Comment: How will the BfE, as the responsible authority for all public participation in the site selection procedure, maintain its independence in the eyes of the public during site selection and determination of a site?
What measures will be taken to ensure the regulator maintains its independence during site selection?

Answer: The BfE as the regulator acts independently from the operator. Its role is to organise the public participation process as it is laid down in the relevant law. The role of the BfE is not to defend the proposals of the operator. This is communicated to the public.

Q.No *	Article	Ref. in National Report
	Article 13	H, 226

Question/ Comment: 1. Radioactive Waste (RW) from Nuclear fuel cycle and operation of NPPs are stored on sites and in Central Storage Facility (CSF). The RWs are planned for deep geological formation. The negligible heat-generating RWs are planned for licensed Konrad repository, which begins operation in 2022, while the repository for the heat-generating is being planned
Are there any significant uncertainties or concerns for committing radioactive waste in Konrad repository and what measures are being considered to address it?

Answer: Radioactive waste with negligible heat generation has to be disposed of in the Konrad repository. For this facility, there are waste acceptance requirements and requirements for the quality control of the waste packages. In addition to these requirements, there are laws, regulations and advices which must be considered, too. For example, there is an ESK (Nuclear Waste Management Commission) recommendation which deals with the storage of waste packages and the changes of waste during this storage period until their disposal: "ESK-Leitlinien für die Zwischenlagerung von radioaktiven Abfällen mit vernachlässigbarer Wärmeentwicklung, revidierte Fassung vom 10.06.2013".

Q.No *	Article	Ref. in National Report
	Article 13	H, 226

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Zwischenlagerung von radioaktiven Abfällen mit vernachlässigbarer Wärmeentwicklung, revidierte Fassung vom 10.06.2013".

Q.No	Article	Ref. in National Report
*	Article 13	H 3.2 –Siting (page 228)

Question/ Comment: It there specified the minimum number of sites required for the third phase of repository site selection procedure? In site selection process the volunteer communities fulfilling the geological stability criteria will be considered?

Answer: The site selection procedure is based on site comparisons in order to find the site with the best possible safety. Accordingly, the Repository Site Selection Act provides for a comparison of at least two sites in the third phase (§19).
The Repository Site Selection Act does not take voluntary communities into account differently from other communities.

Q.No	Article	Ref. in National Report
*	Article 13	H 3.2, p.228

Question/ Comment: In the first phase of the new site selection procedure, it is planned to screen the entire territory of Germany and select the potential host formations for the disposal of heat-generating waste. At the same time, significant resources were already spent in the country on the research of the salt dome in Horlben and on the safety case development of the waste disposal in the salt formations. Is it planned (and how) to use research materials in Horlben when selecting a site in Germany?

Answer: Up to know it is not possible to judge whether the Gorleben salt dome may host a repository with best possible safety or not, and neither the resources already spent nor the state of site specific knowledge support such a judgement. The facilities installed for research or assessment purposes in connection with the exploration of the salt dome will therefore only be used again, if at all, if the Gorleben salt dome proves to be similar or more suitable compared with other sites that have been investigated in a comparable way. In the meantime, the facilities installed at the Gorleben site have been partly dismantled thus only providing access without performing active research. Nevertheless, the research results obtained concerning rock salt as a potential host rock, as well as the scientific expertise built during Gorleben-related research, will surely serve as a valuable methodological and scientific source of information during the upcoming site selection process.

Q.No	Article	Ref. in National Report
*	Article 13	Section Summary pg. 21

Question/ Comment: The decision to decommission the nuclear power plants will result in significant volumes of radioactive waste and spent fuel that require deep geologic disposal. Please elaborate on plans to ensure staff with the required planning and technical expertise will be available to manage the projected future radioactive waste disposal activities.

Answer: A significant contribution to waste management research and, especially, to repository research and to international cooperation is made by the German Association for Repository Research (DAEF) founded on 16 January 2013. The aim of the DAEF is the further development and expansion of cooperation of its members and the use of their cumulative expertise in the field of repository research. These research activities contribute substantially to the development and maintenance of scientific and technical competence and promotion of young researchers in the

field of radioactive waste management.
An important contribution to the development of the Know-how and the promotion of young scientists deliver since many decades the project fundings of the Federal Ministry for Economic Affairs and Energy and of the Federal Ministry for Research and Education.

Q.No *	Article	Ref. in National Report
	Article 13.1.3	E.3.2 p. 228

Question/ Comment: In Germany, all phases of the repository site selection procedure are to be accompanied by intensive public involvement and participation. Could you please provide us examples what this public involvement and participation means in practise?

Answer: According to the Repository Site Selection Act, the Federal Office for the Safety of Nuclear Waste Management (BfE) is required to continuously publish all documents of the regulator and the operator if relevant for the site selection process procedure on the internet. An information platform was launched on 16 May 2017, coinciding with the entry into force of the Act. Since then, the BfE has published essential correspondence in connection with the site selection procedure as well as protocols and reports (www.bfe.bund.de/DE/soa/unterlagen-standag/unterlagen-standag_node.html and www.bfe.bund.de/SharedDocs/Kurzmeldungen/BfE/EN/2017/0516-internetplatform.html). The page is designed as a database with search function. It is planned to continuously develop the information platform regarding user-friendliness and the scope of the information offered. The Act also prescribes several participation platforms. This may be within a regional framework (e.g. in so-called regional conferences) as well as within a supra-regional framework (e.g. in the Council of the Regions).

Q.No *	Article	Ref. in National Report
	Article 15	H 2.1, p.220

Question/ Comment: Which external impacts are considered during safety analysis of RAW?

Answer: The question refers to existing facilities for radioactive waste management, but also applies to those for spent fuel management. In this regard, the following external events have been considered during the licensing procedure as well as during a post Fukushima stress test, the results of which have been published in 2013:

- earthquake
- flooding
- extreme weather phenomena: heavy rain, storms (including hurricanes), hail, snow loads, freezing rain, lightning stroke
- loss of electrical power supply
- external fires
- aircraft crash
- blast waves

While the licensing procedures assessed the adequacy of design basis events at the time of licence application, the stress test, performed by the

Nuclear Waste Management Commission (ESK), dealt with manifestations of the mentioned events beyond the design basis. Two reports on the results of the stress tests have been published via the Nuclear Waste Management Commission's website: http://www.entsorgungskommission.de/en/node/93?page=1.

Q.No	Article	Ref. in National Report
*	Article 15	H 5.4, p.240

Question/ Comment: Following the results of post-Fukushima stress tests on reliability of German NPPs, is it envisaged to develop concept solutions of treatment of large volumes of radioactive water that may accumulate as a result of management of BDBA with severe core damage? If this is the case, what are the main provisions of these concept solutions?

Answer: Mitigating the consequences of a BDBA of an NPP, including the treatment of contaminated water, is beyond the scope of the Joint Convention. However, it is part of the National Action Plan for German post-Fukushima measures and is part of the CNS reporting. Therefore, we would kindly ask the questioners to refer to these reports in questions concerning measures resulting from the post-Fukushima stress tests of German NPPs.

Q.No	Article	Ref. in National Report
*	Article 15	H 5.3, p.239

Question/ Comment: The document uses the terms "final disposal", "final repository". Whether these terms have some specific definition, or they are equivalent to the terms "disposal", "repository"?

Answer: In the context described in the German Report, the term „final disposal" is used as part of the title of two documents ([3-13] and [BMU 10]) referring in general to the process of final disposal. "final repository" is used once to describe a part of the content of [BMU 10], referring to a site specific "final repository concept". They do not have a specific definition and are equivalent to the terms "disposal" and "repository".

Q.No	Article	Ref. in National Report
*	Article 15	H 5

Question/ Comment: Is it planned to make criticality calculations (nuclear safety justification) for facilities that have radioactive waste contained nuclear materials? If so, what safety criteria will be used in the calculations?

Answer: According to §2(1)(4) of the Atomic Energy Act (AtG), substances which permit a self-sustaining chain reaction to be maintained in a suitable installation (and which are defined in a statutory ordinance) are considered as nuclear fuel. §2(3) AtG mainly states that for the application of licensing provisions pursuant to this Act or any statutory ordinances promulgated on the substances in which the proportion of isotopes uranium-233, uranium-235, plutonium-239 and plutonium-241 does not exceed 15 grams in total or the concentration of the isotopes listed does not exceed 15 grams per 100 kilograms are classified as "other radioactive material".
This definition generally applies also to radioactive wastes. Facilities for the storage or handling of nuclear fuels require a licence. One of the

licencing requirements is that “the necessary precautions have been taken in the light of the state-of-the-art of science and technology to prevent damage”. In terms of criticality safety, this usually but not mandatory includes criticality calculations to provide evidence of subcriticality under normal, abnormal and design base accident conditions. Other radioactive material than nuclear fuel containing fissionable materials rely on the limitation of fissile mass and concentration mentioned above, e.g. per waste package.
The general term “state-of-the-art of science and technology” is described most recent and in more detail in the relevant national rules and standards, e.g. the standard DIN 25403 “Criticality safety in processing and handling of fissile materials”, and others. As acceptance criterion, usually, the calculated neutron multiplication factor of a given system has to remain below 0.95 including all uncertainties coming from the code, experimental validation basis, nuclear data, technical tolerances, and others.
Within the licencing processes for the dry spent fuel storage facilities, proofs had been furnished for subcriticality demonstrating that the multiplication factor will remain below 0.95 under normal operation and below 0.97 under accident conditions. For each loading of a cask, the compliance with subcriticality is verified and, where required, additional proofs are furnished.

Q.No	Article	Ref. in National Report
*	Article 16	H6.7, p246

Question/ Comment: Are samples of low and intermediate level waste packages regularly inspected? If yes: (i) how is this sample defined, (ii) are som waste drums opened to control the state of the immobilizing matrix (iii) with which periodicity?

Answer: The inspection programmes, including scope and frequency are developed depending on the storage facility and the waste packages stored there. While some operators conduct yearly visual examinations and inspections of all waste packages in the facility, others use a reference sample concept. As part of the supervision, the competent authorities will check on a case-to-case basis that the inspection programme is sufficient for the facility in question.
In line with the ALARA principle, waste packages without any noticeable damage or degradation effects are usually not to be opened.
Besides, the inspections at ten-year intervals (as described in H 6.7, p. 246), where also the condition of the waste packages is reported, in-service inspections at higher frequencies may be planed depending on the facility and waste packages stored there. The findings of the in-service inspections are also reported in the report following a ten-year inspection.
Recent studies show that older containers have been subject to corrosive processes. This is due to incorrect conditioning procedures. In this respect, the inspection programs must also take into account the conditioning procedures of the time.

Q.No	Article	Ref. in National Report
*	Article 17	H.7.2, 250-251

Question/ Comment: How are institutional measures after the closure of disposal facilities included in German legal framework? If possible, provide details of binding, legal requirements on active and passive institutional control.

Answer	According to § 9a(3) AtG, disposal facilities for radioactive wastes are federal facilities. Therefore, institutional measures after their closure are also the responsibility of the Federal Government and its competent institutions (currently BfE and BGE). In addition to the information provided in Chapter H. 7.2 of the German report, requirements for the type of measures to be taken after closure are not yet specified in detail from a legal point of view. Measures regarding the repository for heat-generating radioactive waste will be specified in time before closing the repository. Institutional control after closure of the Konrad repository is, as reported, regulated in the licence, extent and type of measures being subject to the repository's future closure plan. Procedures regarding the ERAM repository have to be specified in future as well.

Q.No	Article	Ref. in National Report
*	Article 17	p 251

Question/ Comment	In Section H.7.2 it is stated that "The procedures for the ERAM have not yet been specified". Could you provide details about the planned long-term environmental and radiological monitoring programme for ERAM in view of the fact that it is under decommissioning?
Answer	The permanent closure and seal of the Morsleben repository (ERAM) are carried out in such a way that controlling and supervision measurements are not required in the post-closure phase. The proof of the insignificance of possible influences on the biosphere or the earth's surface is a licensing prerequisite for the plan "closure ERAM". The licensing authority can define monitoring measures.

Q.No	Article	Ref. in National Report
*	Article 17	H, 249 - 250

Question/ Comment	2. Disused Sealed Radioactive Sources (DSRS) are returned back to manufacturer or supplier where possible. Otherwise, they are stored as RW in Land collecting facilities (LCFs) with planned disposal in Konrad repository. Between 1998 and 2016, about 37,158m3 of solid low and intermediate level waste and 6621 DSRS were disposed in Morsleben repository (ERAM). The repository remains opened. What timeframe is envisaged over which a reasonable degree of assurance can be placed on institutional control measures for Konrad and ERAM (Morsleben) repositories to contribute to disposal safety?
Answer	The disposal of radioactive waste was stopped in 1998. The closure measures have not started yet. Until the beginning of the closure, the monitoring of the Morsleben repository is carried out following the requirements provided by the sets of rules and the license. The closure and seal of the Morsleben repository (ERAM) are carried out in such a way that controlling and supervision measurements are not required in the post-closure phase. The proof of the insignificance of possible influences on the biosphere or the earth's surface is approval prerequisite for the plan "closure ERAM". The licensing authority can define monitoring measures. At present there are no general specifications for the monitoring in the post-closure phase for repositories for low and intermediate level waste.

Q.No	Article	Ref. in National Report
*	Article 18	E

Question/ Comment	The text reads that, in relation to the implementation of Directive 2013/59/EURATOM in the legislation of Germany, the German Radiological Protection Commission (SSK) has found that additional dose constraints are not needed to improve the protection of the employees subject to occupational exposure. The reason is that SSK recognises the existing legislative provisions as adequate tools for optimisation of employees' radiation exposure. Please specify some of the important regulations ensuring radiation protection in the facilities for radioactive waste and spent nuclear fuel management.
Answer	This question refers to the sentence “For none of the areas examined, the SSK considered it necessary to introduce dose constraints at the level of relevant laws and ordinances for the implementation of Council Directive 2013/59/EURATOM” on p. 118 of the German Report, which could obviously be misinterpreted. The translated full text in relation to NPPs and fuel cycle facilities as well as storage and radioactive waste management facilities reads as follows: “The SSK is of the opinion that the existing regulations and optimisation instruments in radiological occupational health and safety at nuclear power plants are compatible with the requirements of Directive 2013/59/Euratom. Further dose guidelines (dose constraints) in radiological occupational safety in nuclear power plants and fuel cycle facilities are therefore not necessary. … In the case of radioactive waste management facilities and interim storage facilities for radioactive waste that are operated at or in nuclear power plants and nuclear fuel cycle facilities, the radiological occupational health and safety at work corresponds to that of nuclear power plants and nuclear supply facilities. In the opinion of the SSK, further dose guidelines (Dose Constraints) are therefore not necessary in these cases.” The SSK recognizes the existence of a detailed radiation protection scheme in the mentioned facilities that is based on guidelines • Guideline for Physical Radiation Protection Control for the Determination of Body Doses, Part 1: Determination of the Body Dose from External Radiation Exposure (§§ 40, 41, 42 StrlSchV; § 35 RöV) (see citation [3-42-1]), • Guideline for Physical Radiation Protection Control for the Determination of Body Doses, Part 2: Determination of the Body Dose from Internal Radiation Exposure (Incorporation Monitoring) (§§ 40, 41 and 42 StrlSchV) of 12 January 2007 (see citation [3-42-2]), • Guideline concerning the Radiation Protection of the Personnel during Maintenance, Modification, Waste Management and Dismantling Work in Nuclear Facilities and Installations, Part 2: The Radiation Protection Measures during the Operation and the Decommissioning of a Facility or Installation (IWRS II) (see citation [3-43-2]) as well as internal procedures that are agreed upon with the competent authorities. These guidelines specify requirements for evaluation of doses prior to implementation of actions and activities in nuclear installations and associated dose constraints. The conclusion is that in addition to that further dose constraints would not be needed.

Q.No	Article	Ref. in National Report
*	Article 19	E.2.2, 108, 113

Question/ Comment: E.2.2: In September 2014, the role of the regulator has been transferred to the Federal Office for the Safety of Nuclear Waste Management (BfE). According to the hierarchical structure of regulations (Figure E-1), BfE seems not to be responsible for issuing documents for the regulation, as such regulation is either provided by the Federal Government (acts and ordinances), the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and its advisory bodies (guidelines, recommendations) or by safety standard or specifications/manuals coming from the industry (implementer). What will be the role of BfE in the future issuing of regulation documents and what hierarchical level will such documents have with respect to the existing legislation hierarchy? Will there be a separation between regulating tasks given to the advisory bodies (e.g. ESK, SSK) and those tasks given to BfE or will BfE have no task to issue regulation documents at all?

Answer: The BfE does not issue any regulations. It may develop guidelines relevant for its regulatory duties. ESK and SSK are advisory bodies and have no regulatory function. The BfE still may offer advice to the BMU.

Q.No	Article	Ref. in National Report
*	Article 19	page 113, E.2.2

Question/ Comment: Has Germany considered the potential for conflict of interest between the licensing role of the BfE and its other monitoring and public participation roles?

Answer: This issue has been taken into account. The role of the BfE is to inform the public and not to defend the proposals of the operator. Accordingly, no such conflict of interests exists.

Q.No	Article	Ref. in National Report
*	Article 19	page 114, E.2.2

Question/ Comment: Could Germany provide more detail as to how the sum of around 17 million Euros for the payment by the NPP operators to the fund was established? Also how the additional payments of a risk premium to transfer the interest rate and cost risks to the State is calculated.

Answer: The funds provided by the NPP operators consist of a so called basic amount and a risk premium. The NPP operators were obliged to provide the basic amount by law. The basic amount totals to ca. €17.93 billion and will be used to cover the future costs of the storage and disposal of radioactive waste. The NPP operators also had the opportunity to pay a “risk premium”, amounting to a total of ca. €6.21 billion, in order not to be obliged to provide additional capital to the public fund in case of unexpected additional costs in the future.
In return to the payment, the Federation will bear all operational and financial responsibilities in relation to the storage and disposal of nuclear waste. The NPP operators remain responsible for the financing and management of decommissioning of the nuclear power plants and the proper packaging of the nuclear waste.
The basic amount was calculated on the basis of the net present value needed to cover the estimated future costs for the storage and disposal of

nuclear waste. The risk premium was provided on top of the basic amount in order to cover future risks and unexpected cost increases. It amounts to 35.47 % of the basic amount.
The basic amount and the risk premium to be provided by the individual NPP operators were determined by an audit firm on the basis of an expert report commissioned by the Federal Ministry for Economic Affairs and Energy to assess the provisions built by the energy companies to ensure their future payment obligations resulting from the production of electricity from nuclear power, following the "polluter pays" principle. The audit firm provided its expert report ("stress test") in October 2015, concluding that the energy companies were in a position to bear the cost of dismantling the nuclear power plants and of packaging and disposing of the nuclear waste. The provisions made for these purposes by the energy companies amounted to a total of €38.3 billion and were based on estimated costs in current prices amounting to around €47.5 billion (calculated as per end of 2014, in prices of 2014). The audit firm confirmed that the estimated costs were plausible and complete and that the provisions had been correctly incorporated into the companies' balance sheets.
The audit firm conducted its assessment for the stress test as follows:
In a first step, it examined the estimates used by the energy companies to calculate the expected future costs arising from the individual waste management steps – decommissioning and dismantling of the nuclear power plants, packaging, storage and disposal of the nuclear waste. The assessment was based on information and data provided by the energy companies, including – inter alia – estimates provided by Federal Government Authorities and especially by the Federal Office for Radiation Protection. In a next step, the audit firm escalated these costs (in prices of 2014) with a basic inflation rate (1.6 %) and an additional inflation rate considering expected cost increases specifically in the nuclear energy sector (1.97 %). Finally, future costs to be borne by the individual NPP operators in order to fulfil their future payment obligations in the nuclear energy sector were discounted with a rate amounting to 4.58%.
Considering the findings of the stress test, the audit firm then determined the basic premium to be provided by each NPP operator for the purpose of storage and final repository of nuclear waste. (The responsibility for the financing and management of decommissioning and waste packaging remains with the NPP operators.) To determine the risk premium, the audit firm assessed different future scenarios and possible cost increases and concluded that a risk premium of 35.47 % would be reasonable.

Q.No	Article	Ref. in National Report
*	Article 19	Section D3.4 p.80 & Section E2.3 p.126

Question/ Comment
The report talks about the Licensing requirements for the storage of wastes and spent fuels. Point C states that "a description of the precautions provided for in order to comply with §7(2)(3) AtG, i.e. the necessary precautions to be taken in the light of state of the art in science and technology to prevent damage resulting from the erection and operation of the facility".

How does this requirement for the use of "state of the art science and technology" balance against the cost, complexity and time taken to design and develop new facilities and how does this align with the ALARA principle?

Specifically, for the ASSEII mine where there is an increasing risk of a significant release of radioactive materials with time, how has the

	conflicting legal requirements for expediting retrievals and the requirement for using “state of the art technology and science” been managed to minimise risk of exposure to ionising radiation/contamination to operators, the public, and the environment?
Answer	There is no explicit balancing of nuclear safety against economic and similar interests in the licensing process. The ALARA principle is defined in § 6 StrlSchV and for licensing it is understood to be part of the “state of the art in science and technology”. It is the task of the competent authority to check the licensing documentation for fulfilment of this clause. To do this, it will refer to the relevant laws and regulations as well as to technical documents and recommendations provided by advisory bodies such as the RSK, the SSK, the ESK and the KTA. Operators’ and industry interests will be part of the advisory bodies’ considerations, though, and both groups are participating in the KTA. While safety considerations will precede other interests, this may serve as a precaution against postulation of unrealistic or unfeasible requirements. Retrieval of all radioactive waste from the Asse II mine and controlled disposal in a plan-approved repository is ALARA for further generations. The conflict between time needed for development technology for the retrieval and the increasing risk exists. Due to this, emergency preparedness and response measures for the minimisation of radiological consequences after a beyond-design solution inflow are in execution. The Act on Speeding up the Retrieval and Closure of the Asse II Mine (Lex Asse) requires cancelling retrieval if radiological safety for operators, the public and the environment can no longer be guaranteed.

Q.No	Article	Ref. in National Report
*	Article 19.2.3	E.2.4 p. 132

Question/ Comment	Germany’s Atomic Energy Act states that construction, operation and also decommissioning require a licence. Could you please tell us when the decommissioning licence should be applied? And which procedures the licensee of operational licence cannot perform before the decommissioning licence is approved?
Answer	After the final shutdown of a nuclear power plant, the facility is in a post-operational phase, which is still covered by the operation licence. Since the licensing procedure usually takes several years (due to e.g. EIA, stakeholder involvement and TSO involvement), operators should apply for decommissioning in advance, but at the latest in the post-operational phase. Due to the phase-out of nuclear energy in Germany, there are fixed dates for the latest shutdown for each nuclear power plant. Therefore, decommissioning licence applications may be submitted well in advance to keep the post-operational phase as short as possible. During the post-operational phase, before a decommissioning licence is granted, the licensee can perform preparatory works for decommissioning as e.g. defueling, handling of operating wastes, radiological measurements and in general works that are similar to maintenance and refuelling operations and which are covered by the operating license. However, no deconstruction of structures, facilities and components is allowed before the decommissioning license is granted.

Q.No	Article	Ref. in National Report
*	Article 20	E.3.1, 138-140

Question/ Comment: What was the reason to exclude RAW and SF storage and disposal from the competencies of the BfS and create a new regulatory body – BfE? How do these two regulators coordinate their activities and how they interact with competent authorities (at Länder level)?

Answer: Before restructuring took place, BfS fulfilled a number of tasks in the field of radiation protection and nuclear waste management.
When the organisational landscape in the field of nuclear waste management had been restructured, care was taken to assign clear tasks and clear responsibilities to the newly established organisations:
The tasks of a nuclear operator for waste management were concentrated within the BGE. The establishment of the BfE created one central regulatory body for licensing and supervision in the field of nuclear waste management. The BfS is still existent but not is focused on nuclear waste management, but on the vast variety of questions in the field of radiation protection.
The tasks of the Land ministries are clearly assigned, but different from the tasks of the BfE and mostly not connected to nuclear waste management. Concerning the responsibilities for licensing of facilities for radioactive waste disposal it is planned that these responsibilities will be transferred from the Land ministries to the BfE in the near future in order to clarify the roles of the different entities and complete the concentration of tasks relating to regulating nuclear waste management at the BfE.
The restructuring thus creates clear responsibilities in the fields of operation and regulation. Both tasks were previously distributed over several institutions at the level of the Federation and the Länder and the private level and are now concentrated at essentially two main organisations, the BGE as the operator and the BfE as regulator.

Q.No	Article	Ref. in National Report
*	Article 20	E.3.1, 138-140

Question/ Comment: Who regulates decommissioning of nuclear installations in Germany?

Answer: As is the case for operation, the Land authorities execute federal laws and are responsible for licensing and supervision of decommissioning of nuclear installations in Germany. The Land authorities are subject to supervision by the Federation with respect to the legality and appropriateness of execution.

Q.No	Article	Ref. in National Report
*	Article 20	Section E3.1 p.143

Question/ Comment: This section talks about the use of advisory commissions and authorised experts (RSK, SSK and ESK) which provide advice to the different regulatory bodies.

Please provide further information about the process for authorisation of these experts and how their independence is assessed and assured?

Answer	The commissions mentioned here consist of renowned experts of different disciplines, covering a broad range of technical and scientific expertise as well a spectrum of different views on the topics in consideration. The Experts are authorized by the Federal Minister for Environment, Nature Conservation and Nuclear Safety. Thus, the Commissions RSK, SSK and ESK offer their advice and opinion primarily to BMU, either responding to questions from BMU or publishing positions on topics chosen by the respective commission itself. Documents generated in this context are publically available on the commission's websites. The commissions, their committees and working groups act independently, as stipulated in their rules of procedure. Conflicts of interest that may arise from a member's involvement in a topic under discussion are also dealt with transparently according to the rules of procedure. The membership is honorary, so that contractual or economic dependence on the appointing Ministry is avoided. As commission members are chosen to represent different views (e.g. from a university, research, consultancy or industry perspective, be it supportive or critical), it is not intended that all members per se act personally independent from the organisation they come from, but that different perspectives and organisations are represented in the commissions.

Q.No	Article	Ref. in National Report
*	Article 20.1	E.3.1 p. 138

Question/ Comment	In Germany, the organisation of the regulatory body seems quite complex. Could you please give us examples of good collaboration between the organisations?
Answer	In the field of nuclear waste management, cooperation between different entities of the regulatory body takes place in different areas. Based on the German legal system, surveillance of nuclear waste repositories involves different organisations on the federal level and on the level of the Länder. While the Federal Office for the Safety of Nuclear Waste Management (BfE) is the responsible organisation with respect to nuclear legislation and the field of radiation protection legislation, aspects relating to water law are the responsibility of the Land authorities. This means, that there are interrelated thematic areas where interaction and consultation between the organisations need to take place. Any necessary adjustments with respect to the licences under nuclear legislation or under radiation protection legislation are also within the competence of the Länder. In the framework of the licencing process, the BfE will be involved by the licencing authority as the responsible organisation for supervision.

Q.No	Article	Ref. in National Report
*	Article 21	Section F1.1 p.147

Question/ Comment	In section F1.1 on page 147 the report states that to hold a nuclear site licence a number of pre-requisites must be met. The report states "one such pre-requisite is the trustworthiness and technical qualification of the responsible individuals. Certified proof of this pre-requisite and its acknowledgement by the authorities provide the basis for responsible performance under the licence" Please explain the process used to certify someone as trustworthy and how this is inspected/assessed as part of the licensing process. To note, this also relates to Article 22.

Answer Details of the certification process regarding the trustworthiness of responsible staff members are specified in the Nuclear Reliability Verification Ordinance (AtZüV) in accordance with § 12b AtG. The assessment of trustworthiness by the competent authority includes, among others, the following measures:
- the examination of the identity of the individual
- inquiries at police and constitution protection authorities of the Federation and the Federal States
- seeking unrestricted information from the Federal Central Criminal Register or a good-conduct certificate for authorities according to § 30(5) BZRG

The verification of reliability is valid for a maximum of five years. If there are doubts about the trustworthiness of an individual, the competent authority may ask the prosecuting authorities and criminal courts for additional information and, if necessary, for access to records.

Q.No	Article	Ref. in National Report
*	Article 22	Section F1.1 - page 151

Question/ Comment The section 22 explains that provisions are in force in the German regulations to ensure that competent staff are available in the nuclear energy field and that research institutions and networks of competences are aware of the importance of workers skills and knowledge needs for the future.
It is indicated (p. 151) that "competent and motivated personnel will also be needed in future for the tasks to be performed during the phase-out of nuclear energy. The motivation for working in an area with only limited career prospects in Germany can only be maintained if this work is regarded as being important and recognised by society".
The report doesn't provide any forecast about the future need for staff and workers in terms on skills and knowledge and number and planning. Without any forecast and detailed plan about the needs for renew of personnel and the needs for new skills and knowledge especially in the fields of radioactive waste management and decommissioning, according to the industrial policy (use or not of contractors) and the number of organizations (many electricity producers), it's difficult to consider that motivation by importance and recognition by the society will be sufficient.
Could Germany provide more information on the needs for staff and workers and the related skills and knowledge that should be developed in the future to challenge the phase-out programme of the country? Is there any strategic plan at the national level to maintain sufficilent workers and related skills in the future?

Answer Detailed information on staff needs in terms of numbers is part of the decommissioning plans that have to be prepared by the operators. The operators also have to decide on the skills and knowledge needed to perform the decommissioning of their plants efficiently and safely. Decommissioning of a facility is subject to a licence. Within the licencing procedure, the regulatory authorities have to check the planned measures and to decide whether the legal requirements are fulfilled. In particular, a licence may only be granted if it is assured that the persons engaged in decommissioning activities have the necessary knowledge concerning the safety of the installation, the possible hazards and the protective measures to be taken.
Currently, approx. 8,000 people are working in nuclear power plants. A large part of the decommissioning activities will be performed by

experts who were already involved in the construction and operation of the plants. Since the licensing procedure normally takes five years, the operators have sufficient time to adapt themselves to that situation.
There is no strategic plan at the national level to maintain sufficient workers and related skills in the future.

Q.No	Article	Ref. in National Report
*	Article 22	A.3, p.43

Question/ Comment: Could you please provide some examples regarding the fees paid by the waste producers for other radioactive waste and disused sealed radioactive sources?

Answer: § 21a AtG provides that for the use of installations pursuant to § 9a (3), i.e. Land collecting facilities and federal installations for the safekeeping and disposal of radioactive waste, the parties obliged to surrender material shall be charged with costs (fees and expenses).
As an example, the state of Lower Saxony has issued a fee ordinance (Gebührenordnung) that provides the fees for the surrendering of radioactive waste to the Lower Saxony collecting facility. The fee ordinance can be found online using the following link (in German):
http://lsst.niedersachsen.de/language=de/2863/kostenregelung

Q.No	Article	Ref. in National Report
*	Article 22	p 151

Question/ Comment: On page 151, Germany makes a firm statement about the real situation concerning its human resources: "Competent and motivated personnel will also be needed in future for the tasks to be performed during the phase-out of nuclear energy. The motivation for working in an area with only limited career prospects in Germany can only be maintained if this work is regarded as being important and recognised by society. "
Could you provide us with details about the measures planned to cope with the predictable issues concerning the human resources needs?

Answer: Detailed information on staff needs in terms of numbers is part of the decommissioning plans that have to be prepared by the operators. Currently approx. 8,000 people are working in nuclear power plants. A large part of the decommissioning activities will be performed by experts who were already involved in the construction and operation of the plants.
Furthermore, the issue of human resources has been considered in the Waste Management Transfer Act. The responsibility for storage now lies with the Federation, so that the state-owned company BGZ Gesellschaft für Zwischenlagerung mbH entrusted with the task of operating storages for radioactive waste went into business on 1 August 2017. Based on the Repository Site Selection Act of May 2017, a disposal facility for HLW may be commissioned in 2050, so that the responsibility for the storage of radioactive waste still remains with BGZ for several decades. This situation calls for ensuring the professional qualification of the staff. Hence, there is the need for maintaining a sufficient number of skilled and well-educated staff, so that this issue has to be tackled at national level in the near future.

Q.No	Article	Ref. in National Report
*	Article 22	F, 151

Question/
Comment How is financial obligation of operators sustained or ensured? What determine the charges levelled on operators?

Answer The NPP operators were obliged to pay the basic amount by law. In return to the payment, the Federation took over all operational and financial responsibilities in relation to the interim storage and final disposal of nuclear waste. In case of no payment, the NPP operators would have remained in charge for these responsibilities and would have had to pay interest on arrears.

On 3 July 2017, the NPP operators transferred to the public fund the basic amount (ca. €17.93 billion in total) as well as the risk premium (ca. €6.21 billion in total) as defined under the Act on the Reorganisation of the Responsibility in Nuclear Waste Management. The NNP operators do not have an obligation to provide additional capital to the public fund in case of unexpected additional costs in the future.

The basic amount was calculated on the basis of the net present value needed to cover the estimated future costs for the storage and disposal of nuclear waste. The risk premium was provided on top of the basic amount in order to cover future risks and unexpected cost increases. It amounts to 35.47 % of the basic amount.

The basic amount and the risk premium to be provided by the individual NPP operators were determined by an audit firm on the basis of an expert report commissioned by the Federal Ministry for Economic Affairs and Energy to assess the provisions built by the energy companies to ensure their future payment obligations resulting from the production of electricity from nuclear power, following the “polluter pays” principle.

The audit firm provided its expert report (“stress test”) in October 2015, concluding that the energy companies were in a position to bear the cost of dismantling the nuclear power plants and of packaging and disposing of the nuclear waste. The provisions made for these purposes by the energy companies amounted to a total of €38.3 billion and were based on estimated costs in current prices amounting to around €47.5 billion (calculated as per end of 2014, in prices of 2014). The audit firm confirmed that the estimated costs were plausible and complete and that the provisions had been correctly incorporated into the companies’ balance sheets.

The audit firm conducted its assessment for the stress test as follows:

In a first step, it examined the estimates used by the energy companies to calculate the expected future costs arising from the individual waste management steps – decommissioning and dismantling of the nuclear power plants, packaging, storage and disposal of the nuclear waste. The assessment was based on information and data provided by the energy companies, including – inter alia – estimates provided by Federal Government Authorities and especially by the Federal Office for Radiation Protection. In a next step, the audit firm escalated these costs (in

prices of 2014) with a basic inflation rate (1.6 %) and an additional inflation rate considering expected cost increases specifically in the nuclear energy sector (1.97 %). Finally, future costs to be borne by the individual NPP operators in order to fulfil their future payment obligations in the nuclear energy sector were discounted with a rate amounting to 4.58 %.

Considering the findings of the stress test, the audit firm then determined the basic premium to be provided by each NPP operator for the purpose of storage and final repository of nuclear waste. (The responsibility for the financing and management of decommissioning and waste packaging remains with the NPP operators.) To determine the risk premium, the audit firm assessed different future scenarios and possible cost increases and concluded that a risk premium of 35.47 % would be reasonable.

Q.No *	Article	Ref. in National Report
	Article 22.3	F.2.3 p. 153

Question/ Comment: In Germany, the surveillance of a repository after closure will be carried out under government control and the funding is provided through the federal budget. Is there any amount of money collected from the licensees before the closure of the repository for the surveillance?

Answer: Surveillance and monitoring after closure are not part of the safety concept for a disposal facility in Germany as the system is supposed to only depend on passive safety. General surveillance after closure will continue and is a governmental task.

Q.No *	Article	Ref. in National Report
	Article 23	F.3, p154

Question/ Comment: Are destructive tests performed for quality assurance on samples of conditioned waste forms (with qualified or non qualified procedures) to verify that the waste acceptance criteria are well respected? If yes, who is responsible for these tests and how are the samples chosen?

Answer: In Germany, qualified procedures are necessary to proof that the waste package fulfils the waste acceptance criteria of the disposal facility. The applicant of a conditioning campaign (waste owner and/or waste conditioner) lays down his plan of procedure. In his plan, he has to define the amount and kind of samples which are necessary to proof the fulfilment of the waste acceptance criteria (e.g. analysis of the radionuclide spectrum). If somebody would define "taking samples" (e.g. by drilling, scratching, etc.) as "destructive tests", then these kinds of tests are done in Germany.
The applicant is responsible for these tests. He describes the necessary procedures in his plan which is reviewed by the disposal facility operator (BGE) and their technical experts. If the plan is accepted by BGE, which means that the procedures are complete for proofing the fulfilment of the WAC, the applicant can start the conditioning campaign including the listed procedures (e.g. taking samples of the waste product or in case of historic waste from the waste package). The plan must also define the amount of controls necessary for specific procedure steps (e.g. taking a sample). These steps are controlled by the technical expert of the BGE.

Q.No	Article	Ref. in National Report
*	Article 23	F.6.1, p.183

Question/ Comment (1) How often does the regulatory body carry out the inspection during decommissioning? What are the main contents of decommissioning inspection?

(2) Is there the inspection guidelines or regulations for decommissioning completion?

(3) Is there the guidelines or manuals for radiation survey and site investigation after decommissioning?

(4) How can regulatory body carry out the verification of site investigation result submitted by decommissioning licensee? Is there the guideline or regulation for the verification?

Answer (1) § 19 (1) AtG stipulates, among other things that the handling of radioactive substances and the possession of facilities of the type referred to in § 7 AtG shall be subject to state supervision. Thus, the decommissioning of nuclear facilities and all other measures associated with safe enclosure or dismantling are subject to supervision under nuclear law, as was the operation of the facility before its decommissioning. Within the framework of supervision (accompanying control), the nuclear licensing authority must ensure that, in particular, the provisions of the licence pursuant to § 7 (3) AtG are considered. According to § 20 AtG, the nuclear supervisory authority may consult authorised experts for this task. This requires clear formulation of the subject of the licence. Accordingly, it has to be checked already before granting of the licence whether the planned methods and processes are appropriate and defined clearly enough for decommissioning and whether they ensure the necessary precautions against damage according to the state of the art in science and technology during execution of the planned decommissioning measures. In this respect, it is also to be defined in the licence whether and to what extent decisions, e.g. on methods and processes to be applied during the individual work steps, may remain reserved for the permit procedure within the framework of supervision. According to §19 (2) of the Atomic Energy Act, the competent authority or the experts acting on behalf of the competent authority have a permanent right to enter the nuclear facility also during decommissioning. In practice, the number of days per week during which staff of the authority is present in a facility varies. In early decommissioning projects such as NPP Würgassen, staff of the authority was present several days per week and staff of the expert organisation acting on behalf of the authority was present each day of the week for several years. The presence of staff of the authority and the expert organisation varies according to the complexity of the facility and the ongoing decommissioning activities and may be only occasional e. g. in the case of research reactors.

(2) The supervision is carried out by the competent authority of the Federal State within the scope of the federal executive administration for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety according to its own discretion. This also includes completion of decommissioning, which for nuclear power plants is usually “green field” conditions (i.e. no buildings of the former controlled area left in place and the site cleared on the basis of the 10 Microsievert concept, above background radiation).

(3) The most comprehensive standard for measurements in connection with clearance is the German Standard DIN 25457. Part 7 of this Standard deals with measurements on sites (land) and soil that is removed from this site in relation to free release of this land.

(4) The competent authority performs control measurements on its own or by experts acting on behalf of the authorities. The measurement methods and the amount (percentage) of control measurements are laid down in the clearance license. Furthermore, the documentation of

clearance measurements is subject to a detailed scrutiny.

Q.No	Article	Ref. in National Report
*	Article 24	F.4

Question/ Comment: The Report stipulates that LLW generated by the nuclear facilities may be free released when complying with the criteria specified in the Germany's radiation protection regulation (StrlSchV).
Who is authorised to verify compliance of the waste (materials) with the criteria for free release and who identifies the procedure/methods to be used in this verification?
Would you specify the Licensee's obligations in the free release process.

Answer: In Germany, any type of radioactive waste as well as low level waste will be disposed of in a deep geological formation.
However, in the administrative act of clearance, it is verified that the activity of substances is that low that it is negligible, i.e. the 10 Microsievert criterion is fulfilled. Due to the German Atomic Energy Act and the Radiation Protection Act cleared substances are after clearance no longer radioactive substances; so they are no low level or very low level waste or any other type of radioactive material.
The licensee is in charge of the clearing process. He has to apply for a clearing license at the competent authority. The clearance criteria to be fulfilled by the licensee are laid down in detail in § 29 and corresponding appendices of the Radiation Protection Ordinance. The clearing process is inspected by a technical support organisation and supervised by the competent authority.

Q.No	Article	Ref. in National Report
*	Article 24	F.4.5, p.164

Question/ Comment: F.4.5 describes discharge monitoring of effluents generated from operating nuclear facilities.
(1) In general, sampling and analysis should be implemented before the gaseous radioactive effluents are discharged to environment. Please explain the sampling method, sampling time(duration), analysis frequency, and radionuclides to be analyzed, for particulates, noble gas, iodine, C-14 and H-3 in the gaseous effluents.
(2) Sampling and analysis should be implemented before the liquid radioactive effluents are discharged to environment. Please explain the sampling method, sampling time(duration) and analysis frequency for difficult-to- measure radionuclides such as C-14, Ni, Fe, Sr-89, Sr-90 in the liquid effuents.

Answer: The requirements for the monitoring of discharges into the air for specified normal operation releases are described in the standard KTA 1503.1. This standard applies to nuclear power plants and can be transferred analogously to other nuclear facilities with similar discharges. The discharge of radioactive noble gases with the exhaust air shall be monitored by a continuous measurement of the activity concentration with beta/gamma or beta detectors and the volumetric flow of the exhaust air. The discharge of radioactive substances bound to aerosols shall be monitored by a continuous measurement. For this purpose, the radioactive substances bound to aerosols shall be continuously deposited from a partial air stream on a high-efficiency particulate air filter with the activity on the filter being continuously measured during this process. For a detailed assessment, the radioactive substances bound to aerosols shall be continuously accumulated on two separate high-efficiency particulate

air filter. The accumulation time span shall not exceed one week. Gamma emitters (every week) as well as Strontium-89/90 and alpha emitters (in quarter annual intervals on mixture samples) shall be determined. Tritium in the chemical compound form of water and Carbon-14 in the chemical compound form of carbon dioxide discharged with the exhaust air shall be monitored. For this purpose, samples shall be continuously accumulated and tritium in the samples shall be determined in quarter annual intervals.
The requirements for the monitoring of waste water discharge are described in the standard KTA 1504. Prior to discharge, a sample representative of the entire contents of the transfer container shall be taken. One litre of the sample shall be used for the decision measurement and kept as a sample for a period of one year (one-litre sample). From other parts of the sample, weekly, quarterly and annual mixed samples for the balancing and monthly mixed samples for the evaluation of tritium shall be prepared in proportion to the amount of derivation. To calculate the activity, the weekly mixed samples are to be analysed by gamma spectrometry. The quarterly mixed samples shall be analysed for their content of strontium-89 and strontium-90 as well as total alpha activity. The annual mixed samples are to be examined for their content of iron-55 and nickel-63, the monthly mixed samples for their tritium content.

Q.No	Article	Ref. in National Report
*	Article 24	F.4.6, p. 165

Question/ Comment: The Report says that "The further use or recycling of cleared objects and materials is common practice. Examples are … recycling of metals for the production of waste containers for radioactive waste, but also for unrestricted conventional recycling (e.g. steel, aluminium, copper), …"
How many waste containers are fabricated annually and what activity such metal has?

Answer: The German Radiation Protection Ordinance (RPO) does not demand the documentation of end products that contain cleared substances. § 70 RPO demands the documentation of the facility that is used for restricted clearance, if clearance is not unconditional - for instance the landfill, the incineration facility or the facility for melting into scrap metal. The activity of cleared substances is negligible, i. e. it has to be measured to fall below the clearance values listed in Appendix III Table 1 of the RPO – or the activity has to be proven to meet the 10 Microsievert criterion in a case-by-case study. Therefore, it is not possible to give a number of waste containers produced from cleared substances or provide activity values.

Q.No	Article	Ref. in National Report
*	Article 24	F 4.1, p.159

Question/ Comment: Germany plans to reduce maximum occupational exposure dose for the eye-lens to 20 mSv per calendar year according to 2013/59/Euratom requirements of December 5, 2013 and plans to apply no additional national limits. What are the national limits meant?

Answer: The current Radiation Protection Ordinance has additional dose limits for the gonads, the uterus, the bone marrow (red), the thyroid gland, the bone surface, the colon, the lungs, the stomach, the bladder, the chest, the liver and the oesophagus (cf. Table F-1). These limits were reappraised and it was determined that the dose limit for the effective dose provides an appropriate protection for these organs. Therefore, these additional dose limits will be rescinded when the new Radiation Protection Act comes into effect.

Q.No	Article	Ref. in National Report
*	Article 25	170

Question/ Comment: On-site emergency planning are establish by the operators of nuclear facilities, does regulatory body such as BMUB or Lander approve or check them?

Answer: The competent authority approves the operators on-site emergency planning. This is an authority of the Land where the nuclear facility is situated.

Q.No	Article	Ref. in National Report
*	Article 25	F.5.1

Question/ Comment: It is stated that no special emergency preparedness measures are required for a nuclear facility (such as spent fuel storage of ZNL) if the activity of the radioactive substances handled there does not exceed certain limits.
What is the technical basis of the limit value?

Answer: The German report explains that some of the radioactive waste management facilities do generally not require emergency planning since the possibility of safety-relevant events can be excluded. It is also stated in the report that this usually concerns the handling of radioactive material subject to licensing under § 7 StrlSchV. Handling or storage of spent fuel or fissile material in general is not subject to licensing under § 7 StrlSchV.

Q.No	Article	Ref. in National Report
*	Article 25	F 5, p.176

Question/ Comment: What is the mechanism of updating emergency plans on-site (and off-site) of the SF and RAW treatment facility?

Answer: Emergency plans will be reviewed and, if necessary, adjusted if, for example, new evidence becomes available. This was the case, for example, after the accident in Fukushima. Adjustments will also be made when a new legal situation arises, such as the directive 2013/59/Euratom.

Q.No	Article	Ref. in National Report
*	Article 25.1	F.5.1, p.171

Question/ Comment: Can you please provide more information related with the studies conducted on off-site emergency preparedness and response in Germany after the Fukushima accident, including what this studies consisted of and what the most important findings and recommendations are?

Answer: On the basis of the lessons learned from the Fukushima accident, the technical foundations of Germany's emergency preparedness and the accompanying regulations were reviewed. The range of accidents included in the contingency planning was redefined to more closely reflect an accident's potential impact rather than its likelihood. This review has shown that the emergency preparedness planning areas near nuclear power plants had to be revised.
An INES level 7 source term was used for performing calculations with RODOS (Real-time Online Decision Support System) by the BfS for

three areas representing the various climatological conditions in Germany. Nuclear power plants in such areas were then selected (Unterweser, Grohnde and Philippsburg) and calculations were performed for every day of one year using the meteorological data of these locations in the period from 1 October 2011 to 30 September 2012. The results of these calculations were then compared with the emergency reference levels for sheltering, evacuation and consumption of iodine tablets. All of the calculations were performed and evaluated for adults and small children (aged 1 to 2). Individual calculation evaluations were performed, such that for each measure, the maximum distance from the point of emission was determined up to which a measure would have to be carried out upon application of the respective emergency reference level. In order to determine the area where major deterministic effects could occur, additional calculations of the red bone marrow dose were performed for adults and small children (aged 1 to 2) along with the dose for the foetus.
For each plant and emergency response measure, a statistical distribution of the measure's maximum distance was plotted. The cumulative frequency was used to determine the distance up to which a certain measure should be planned and also provides the percentage of calculated planning areas for emergency response near nuclear power plants. The 80th percentile of the cumulative frequency for the maximum distance of a specific measure was used to derive the planning radius. This procedure resulted in a planning area "central zone" (radius 5 km, sheltering, distribution and consumption of iodine tablets, evacuation within 6 hours), "middle zone" (radius approximately 20 km, sheltering, distribution and consumption of iodine tablets, evacuation within 24 hours), "outer zone" (radius approximately 100 km, sheltering, distribution and consumption of iodine tablets) and "entire territory of the Federal Republic of Germany" (providing iodine tablets to children and young people up to the age of 18 and to pregnant women).

Q.No	Article	Ref. in National Report
*	Article 25.1	F.5.1, p.171

Question/ Comment: What are the means used by the individual disaster control authorities for notifying the general public? Are these notifications and the information included (e.g. in terms of the format of the information provided) predetermined, as part of the emergency plans of the control authorities?

Answer: The essential information aspects provided in an emergency is set out in Annex 7 of the German Radiation Protection Law. This information includes:
- information on the occurrence of an emergency and, if possible, its origin, expulsion and expected development,
- behavioural recommendations according to the circumstances of the emergency (e.g. restriction of consumption of certain potentially contaminated foods and potentially contaminated water, hygiene and decontamination rules, recommendations for in-home conduction, collection and use of iodine tablets or other protective active ingredients, demonstrations for the case of evacuation),
- information about the relevant communication channels, preparatory recommendations for bodies having public duties and recommendations for special affected professionals if the emergency precedes a pre-warning phase,
supplementary information on basic concepts of radioactivity and its effects on humans and the environment.

Q.No *	Article Article 25.1	Ref. in National Report F.5.1, p.173
Question/ Comment	Can you please elaborate more on the scope and content of the "precautionary radiation protection"?	
Answer	Precautionary radiation protection comprises measures below the threshold of disaster response. Especially, it includes measures to prevent or reduce the ingestion of radionuclides via food. There are measures that serve to prevent or reduce the contamination of agricultural products by recommendations given to agriculture and also measures to control the contamination of food.	

Q.No *	Article Article 25.2	Ref. in National Report F.5.3, p.179
Question/ Comment	What type of accidents are taken into account for assessment of off-site emergency planning needs for the radioactive waste management facilities (e.g. in storage Land collecting facilities)? Could you please share some information about the methods and tools and the radiological criteria (e.g. reference levels, dose criteria) typically used in these assessments? Are there relevant regulatory requirements?	
Answer	For assessment of off-site emergency planning needs at radioactive waste management facilities, several severe impacts are considered. Often, an aircraft impact causes the highest releases of radioactive material. A criterion to assess the need of off-site emergency planning is whether evacuation may be required at the location of the next residential development or workplace. The dose criterion is 100 mSv by inhalation and external irradiation for a person staying outdoors for 7 days.	

Q.No *	Article Article 25.2	Ref. in National Report F.5.3, p.179
Question/ Comment	Although the information provided for the new structure of the emergency system is comprehensive, a schematic of the new structure, in particular outlining the different levels of emergency plans, would also be useful.	
Answer	Thank you very much for your comment. We will take your proposal into account for our seventh national report.	

Q.No *	Article Article 26	Ref. in National Report Section D.5.6/p. 94
Question/ Comment	What is the concept for the disposal of the RAW originating from the operation and decommissioning of the NPP Greifswald?	
Answer	In Germany, disposal in deep geological formations is intended for all types of radioactive waste.	

Q.No	Article	Ref. in National Report
*	Article 26	Section D.5.6 / p. 94

Question/ Comment: When is the completion of the decommissioning of KGR Greifswald foreseen?
What is the total volume/mass of radioactive waste arising from decommissioning of units 1-4, alternatively 1-5 of KGR?

Answer: A reliable date for the completion of the decommissioning process for NPP Greifswald (KGR), i.e. completion of the “green-field status” after clearance and demolition of all buildings and release of the site, can currently not be provided due to uncertainties in the boundary conditions as start of operation of the repository Konrad, uncertainties in the duration of the clearance procedure for buildings of the reactor blocks and auxiliary systems etc.
The total quantity of materials that originate from the decommissioning of KGR encompass the total mass which has been estimated as 1.8 million Mg, around 570,000 Mg of which (metallic components, building rubble and building structures) will either have to be disposed of as radioactive waste, or else released following decontamination and clearance measurements. Experience from the current progress of this decommissioning project shows that the percentage of radioactive waste will amount to a few percent of these quantities.

Q.No	Article	Ref. in National Report
*	Article 26	Section D5 p.99

Question/ Comment: The section about the WAK and VEK reprocessing and vitrification facilities talks about the remote dismantling of the HAWC equipment due to high dose rates.

The details of remote dismantling are not provided.

Please provide further information on the remote dismantling and the strategy for decommissioning the HAWC cells including decontamination and disposal following dismantling.

Answer: Since the cells with the large storage tanks are accessible only from the same level, here, the decommissioning takes place horizontally. A new access building was built for the waste logistics and the remote dismantling equipment.

The basic device for the remote-controlled horizontal dismantling is a commercially available, electro-hydraulically driven small excavator, which has been adapted to the specific conditions of use. A single-arm manipulator system, which has various tools such as cut-off machines, sword saw and hydraulic shears, can be connected remotely. For concrete demolition work equipment such as concrete cutter and chisel can be attached to the excavator.

In 2015, preparations for the dismantling of the first of the four large storage tanks began. For this purpose, a 1.80 m thick wall had to be sawn away remotely. The sawed block was pulled with a special device and weighed about 30 tons. It was disassembled in the upstream room in

transportable pieces.
Access to the first large storage tank was thus created and its disassembly has begun.

Q.No	Article	Ref. in National Report
*	Article 26	Section D.3.3 pg. 75

Question/ Comment: The report indicates that to address recommendations by the Nuclear Waste Management Commission on the closure plan for the Morsleben repository for radioactive waste, additional analyses must be conducted. Please describe the recommendations and the analyses that must be conducted to address them, as well as the anticipated time frame for their completion.

Answer: The German Nuclear Waste Management Commission (ESK) has evaluated the post-closure safety analyses provided by the Federal Office for Radiation Protection (BfS) to the licensing authority in 2009. In 2013, the ESK has given six recommendations to the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) to improve this safety analyses to account for the state-of-the-art as of 2013. BMU has tasked BfS to implement the recommendations into its documentation in the frame of the licensing procedure.
The recommendations deal with
1. a discussion of the concept of the Containment Providing Rock Zone and an appropriate time frame for comprehensive post-closure safety assessments taking into account the timely evolution of the hazard potential of the waste disposed of,
2. an evaluation of the meaningfulness of such calculation cases that result in the highest radiological consequences,
3. the requirement of taking into account both the dilatancy and the fluid pressure criteria in the geomechanical calculations that are performed to proof the integrity of the salt barrier,
4. the proof that the model abstractions made in the models to assess the post-closure radiological consequences are valid,
5. the requirement to develop a comprehensive list of features, events and processes and to group the resulting scenarios into classes of their probability of occurrence according to the German Safety Requirements for Heat-generating Radioactive Waste as of 2010, and
6. to systematically and comprehensively deal with all uncertainties including uncertainties due to the future development of the disposal system, and model and parameter uncertainties.
The ESK had the opinion that the proof of the post-closure safety of the ERAM according to the state-of-the-art is possible and that the work necessary to account for their recommendations is manageable and limited.
BfS and now Bundesgesellschaft für Endlagerung (BGE) worked to fulfil the recommendations since 2013. The work on recommendations 1 and 2 has been finalized in 2018 and 2015 respectively. The results of recommendation 1 are now discussed with the licensing authority. Work according to recommendations 3 and 5 is underway and work according to recommendations 4 and 6 is planned taking into account the project time table.

Q.No	Article	Ref. in National Report
*	Article 26.1	page 184, F.6.2

Question/ Comment: With the operating staff being trained in decommissioning and staffing is covered by the decommissioning fund, what fraction of the operating staff will be retained when operations cease and decommissioning begins?

Answer: The fraction of the operating staff being retained for decommissioning depends on the decommissioning strategy for each nuclear power plant. Generally, in the case of immediate dismantling, the staff is continued to be employed (cf. answer to your question regarding immediate dismantling). When choosing the option of safe enclosure, new staff must be recruited when dismantling begins.

Q.No	Article	Ref. in National Report
*	Article 27	Section I p.253 - 258

Question/ Comment: The German report states “Transboundary movements of spent fuel and radioactive waste are, according to Council Directive 2006/117/EURATOM [1F-35], subject to licensing in Germany (and in other Member States of the European Union (EU)).” No mention is made of Article 4(4) of Council Directive 2011/70/Euratom
Reference is made to the European Council Directive on the supervision and control of shipments of radioactive waste and spent fuel (Council Directive 2006/117/Euratom). Are any shipments also subject to an agreement under the European Council Directive on the safe management of spent fuel and radioactive waste (Article 4(4) of Council Directive 2011/70/Euratom)? If so, please provide details.

Answer: As a general principle of Germany´s waste management policy, the management of radioactive waste shall as a rule be carried out within German national responsibility. Disposal is to take place on German national territory. This is one of the principles laid down in the national programme according to Council Directive 2011/70/EURATOM (www.bmu.de/en/topics/nuclear-safety-radiological-protection/nuclear-safety/details-nuclear-safety/artikel/national-programme/).
From a legal point of view, in Germany, radioactive waste is to be delivered to a repository (Atomic Energy Act).
According to § 1(2) of the Repository Site Selection Act, no agreements shall be concluded between the Federal Republic of Germany and other states in accordance with the provisions of Council Directive 2011/70 / EURATOM of 19 July 2011 setting up a Community framework for the responsible and safe management of spent fuel and radioactive waste (in particular Article 4(4)) which would allow shipments of radioactive waste including spent fuel for the purpose of disposal outside Germany.

Q.No	Article	Ref. in National Report
*	Article 28	J. p.269

Question/ Comment: The biggest obstacle to the return of a sealed source imported from abroad is when it is difficult to use proper transport packaging.
It is described that Germany has the regulatory requirements for re-entry of disused sealed source, which implies that the national policy is to accept the re-entry of the radioactive sources onece exported to other countries. Then, it is likely that the supplier of the sealed source will need to maintain the design approval so that appropriate transport packaging can be used when the source is returned.
Is there a national system or policy to support such practice in Germany?

Answer	There is no legal obligation for a supplier of sealed sources to maintain the approval under transport regulations for a specific transport container in prospect of a return of a specific source in the future. It would always be possible to use a different type of transport container when the return of a source is pending.

Q.No	Article	Ref. in National Report
*	Article 28	J.1.3, 271

Question/ Comment	Germany is actively involved in improving the safety of the sealed radioactive sources management, also in different countries. Montenegro express compliments to example of successful bilateral cooperation with Ukraine due which was possible to achieve that a large number of sealed radioactive sources, were recorded and safely stored with regard to radiation and physical protection aspects. 1. Could Germany explain whether bilateral cooperation with other interested countries can be established with possibility of import and disposal of small number of disused radioactive sources of category 4 and 5 in Germany on commercial base?
Answer	Germany is interested in enhancing nuclear safety and security on an international scale based in particular on the fundamental principles laid down in the IAEA's "Code of Conduct on The Safety and Security of Radioactive Sources (CoC)" in the currently valid version of 2004, as well as in the "Council Directive 2003/122/EURATOM on the Control of High-activity Sealed Sources and Orphan Sources", the so-called HASS directive (High Activity Sealed Source – HASS), adopted in the year 2003. In this context, bilateral support has been provided in the past in connection with the management of disused sealed sources in the Ukraine since the specified safety and security levels were not reached there in part. It was especially high-active orphan or unsafely stored sources that were put in safe storage. The aim of the support that has been given by Germany so far and which is still ongoing in connection with the salvaging of unsafely-stored sources in the Ukraine is not only to achieve an immediate enhancement of safety and security but also to support the authorities involved in establishing waste management procedures in the Ukraine. In addition, Germany is taking part in a multilateral exchange of information about the Ukraine, regarding the safety and security of nuclear installations and radioactive sources. Bilateral co-operation with other interested states regarding an exchange of information and experience is possible. However, German legislation on principle makes it impossible to import any radioactive waste, hence also disused sources, into Germany. The import of radioactive sources that are intended for conditioning or further use is possible and is subject to approval by the Federal Office for Economic Affairs and Export Control.

Q.No	Article	Ref. in National Report
*	Article 28	Section J.1.1/ p. 264

Question/ Comment	What is the financial model of resources to cover the costs of disposal of disused sealed radioactive sources as radioactive waste (transport, processing, temporal and final storage).

Answer Disposal of disused sealed radioactive sources as radioactive waste is paid for by the owner of these sources. The following two models have to be distinguished:

- NPPs, operators of facilities with licences according to § 7 of the Atomic Energy Act: The sources are kept in their own storage facilities until they can be conditioned together with other radioactive waste for disposal. The electric power utilities made a payment of a basic amount and an optional risk premium into a public-law fund for the future costs of storage, waste conditioning as well as for construction, operation and closure of a repository (polluter-pays principle).
- Research, industry and medicine with licences according to § 7 of the Radiation Protection Ordinance: The sources are handed over to the Land collecting facilities (Landessammelstellen) where the sources are kept and eventually conditioned together with other radioactive waste and sources until they can be conditioned for disposal. The owner of the source transfer ownership of the source to the State against a fee that covers costs for storage and disposal.

Q.No	Article	Ref. in National Report
*	Article 28	Section J, page 268

Question/ Comment What is the national policy related to the orphan sources. Who is responsible for covering the costs for management of orphan sources, e.g. sealed radioactive sources found in scrap metal?

Answer The finder of orphan sources that are detected e.g. in entrance measurements at scrap yards or landfill sites, at border controls or at any other occasion has to report the finding to the competent authority that will then decide about the next steps. Usually, the source is adequately secured and put into a shielding container to reduce exposure as far as possible. It is then transported to a Land collecting facility (*Landessammelstelle*) where it is kept until it can be conditioned for disposal in the Konrad repository (or, if it is a source of low activity with appropriately short half-life, may be cleared). The costs for this procedure have to be borne by the owner of the source, if it is possible to identify an owner, or by the person legally responsible for the source (e.g. the owner of facility where the source was discovered). The costs can be covered by the state, if the costs for securing and keeping the source in the Land collecting facility will exceed the financial means of the owner or the person responsible for the source.
There is no fund in Germany from which the costs can be covered.

Q.No	Article	Ref. in National Report
*	Article 28	Section J.1.1 pg. 263-264

Question/ Comment In cases where the acceptance requirements of an individual land collecting facility are restrictive or prohibitive, please describe how disused sealed sources are managed, particularly high-activity sealed sources that are designated as waste.

Answer Delivery of radioactive materials and radioactive waste is regulated in the Radiation Protection Ordinance. For example, § 69(5) StrlSchV stipulates for high-active radioactive sources that once they have reached the end of their intended period of use, their delivery to the manufacturer, to the shipper or to another licence holder or their delivery as radioactive waste or their storage is admissible.
§ 76 StrlSchV regulates the prerequisites under which radioactive waste has to be delivered to a Land collecting facility or to a federal

repository, with the waste producer in the latter case having to store the waste prior to delivering it to the federal repository (§ 78 StrlSchV). According to § 77 StrlSchV, exceptions from the obligation to hand the waste over are possible in certain cases.
The waste producer has to announce the delivery of radioactive waste to the Land collecting facility by submitting special forms. On the basis of these submitted documents, the Land collecting facility assesses whether the acceptance requirements are met. If adjustments are necessary, this is communicated to the waste producer. Only if there are no more complaints does the Land collecting facility grant the approval for delivery. Conditioned radioactive waste can also be transferred in compliance with special acceptance requirements by the Land collecting facility. Radioactive waste that does not meet the acceptance requirements can be delivered upon application to the Land collecting facility and with the consent of the competent authority in individual cases.

Q.No	Article	Ref. in National Report
*	Article 32	B1.5

Question/ Comment: Chemical composition of the waste seems not to be detailed in the development of the waste acceptance criteria. What are the waste acceptance criteria used with regard to the chemical aspects in order to preserve the integrity of radioactive waste?

Answer: The description of the chemical composition of the waste packages is an obligatory requirement of the license for the Konrad repository and so it has to be considered in the waste acceptance requirements for the Konrad repository. Corresponding to the supplements in the waste acceptance requirements, a respective waste package quality assessment and quality control manual has been issued.
In the main part of waste acceptance requirements, a section is added in which, in a general way, the requirements of the water law permit are summarised. The procedure of describing the composition of a waste package is presented in addendum IV of the Konrad waste acceptance requirements. Addendum IV also contains the commitment of using the material and container list and the threshold values for the materials of the water law permit.
The description of the composition of a waste package has to be provided on the waste data sheet. Format and content are given in addendum VI.
Quality control must be performed to check the compliance of the description with the actual waste package. The quality control process is described, control quantities are stated and suitable control procedures are presented. The control measures to verify the material composition integrate well in the established quality control framework for radioactive waste.
The waste producer has to describe his waste package in a standardised way on the base of the lists of materials and containers. For each material in the list, a comprehensive description is given comprising the composition, scope of application, quality control measures, thresholds and other data. The material list is a living document which will continuously be updated to the demands of the waste producers. Chemical analyses of the waste package content are not required for monitoring, registering and balancing the harmful substances.

Q.No	Article	Ref. in National Report
*	Article 32	B.1.1, 45; B.1.3, 46

Question/ Comment: Which document(s) contain national policy and strategy on RAW and SF management and what is the formal procedure of its (their) approval by Bundestag (Bundesrat, President,…)?

Answer: Germany's strategy for the responsible and safe management of spent fuel and radioactive waste is set out in its national programme (in accordance with the Directive 2011/70/Euratom). The national programme consists of an overarching document giving a programmatic overview of German waste management policy (Programme for the responsible and safe management of spent fuel and radioactive waste [national programme]) and four appendices (Report for the Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Report on the Implementation of Directive 2011/70/Euratom, Inventory of Radioactive Waste, and Report on the cost and financing of the disposal of spent fuel and radioactive waste). These documents can be obtained on the Federal Ministry´s website (www.bmu.de/en/topics/nuclear-safety-radiological-protection/nuclear-safety/details-nuclear-safety/artikel/national-programme/).
The Federal Environment Ministry carried out agency and public participation on the programme before its adoption. The programme and its appendices were adopted by the German cabinet on 12 August 2015.

Q.No	Article	Ref. in National Report
*	Article 32	B.1.5, 49

Question/ Comment: How is in the practice implemented the new RAW classification scheme in Germany and how is it reflected in the national RAW management policy (construction of separate disposal facilities for different RAW classes, …)?

Answer: The actual IAEA scheme (GSG-1) has not been adopted in the German waste classification. GSG-1 sets out a general scheme for classifying radioactive waste primarily based on considerations of long-term safety, i.e. on the minimum appropriate disposal method.
In Germany, disposal in deep geological formations is intended for all types of radioactive waste. For this reason, in Germany, the classification of radioactive waste was carried out with regard to the relevant aspects for disposal. Thus the classification of radioactive waste must comply with the requirements for safety assessment of an underground repository. In this respect, the effects of heat generation from radioactive waste on the design and evaluation of a repository system are particularly important, since the natural temperature conditions may be significantly altered by the waste emplaced. Accordingly, waste is initially subjected to a basic subdivision into

- heat-generating radioactive waste and
- radioactive waste with negligible heat generation.

The basic subdivision into heat-generating waste and radioactive waste with negligible heat generation will also be made if the waste packages to be disposed of are kept in long-term surface storage prior to their transportation to a repository.
The term "radioactive waste with negligible heat generation" was quantified within the scope of the planning work for the Konrad repository in the 1980s. This type of waste involves LLW and a part of ILW. Heat generating waste could not be disposed of in the Konrad repository. For

this reason a siting process for a repository for heat generating waste has started in Germany.

Q.No	Article	Ref. in National Report
*	Article 32	D.3.4, 80-81

Question/ Comment: What was the scientific background for the decision to retrieve all RAW from Asse II mine? Why a law on Asse II mine closure has been adopted before more knowledge about the condition of the RAW and the emplacement chambers were gained and at least some infrastruction for management of RAW has been developed?

Answer: The decision to retrieve all RAW from the Asse II mine is based on a comparison of three closure options as to how Asse II can be safely decommissioned. According to the present state of knowledge, the best variant of how to further deal with the radioactive waste emplaced in the Asse II mine is to retrieve the waste. Apart from the retrieval of the waste, the complete backfilling of the mine and the relocation of the waste to deeper parts of the Asse II mine have also been examined. According to the present state of knowledge, proof of long-term safety, which is required by nuclear law, can only be achieved for the option of retrieving the waste.
Based on the result of the comparison of options, the so-called Lex Asse (§ 57b AtG - Act on Speeding up the Retrieval and Closure of the Asse II Mine) fixated the retrieval legally as the decommissioning option to be pursued. Furthermore, the new law created legal provisions - for example allowing parallel action - which help speed up the retrieval and therefore the safe decommissioning.

Q.No	Article	Ref. in National Report
*	Article 32	Summary - page 29

Question/ Comment: It is indicated in the German Report (p. 29) that "on 16 June 2017, the Act on the Reorganisation of Responsibility in Nuclear Waste Management [1A-31] entered into force. […] The operators transfer the financial means into a public-law fund established with entry into force of the Act in the legal form of a foundation, which provides the Federation or a third party to be established by the Federation with the funds for the waste management steps to be carried out […].The operators of the nuclear power plants will continue to be responsible for the entire management and financing of decommissioning, dismantling and proper packaging of the radioactive waste. The responsibility for action in the fields of storage and disposal lies with the Federation. The related tasks are performed by the publicly owned companies and financed by the fund. The financial resources of around 24 billion euros were provided to the Federation by the operators and transferred to a fund, organised as a foundation under public law, in the beginning of July 2017. [...] The spent fuel and radioactive waste, as well as the storage facilities defined in the Act, will be transferred to the Federation.
According to the specific situation in Germany, the transfer of responsability for action in the field of storage and disposal to the Federation seems to be an appropriate strategy.
Could Germany provide more information on the planning associated to the (progressive or not) transfer of storage faciliites between German Utilities (EnBW, E.ON, RWE and Vattenfall) to the Federation and then to the Federal Company for Radioactive Waste Disposal (Bundesgesellschaft für Endlagerung mbH - BGE?
Coud Germany explain how the amount of funds has been assessed and what are the related assumptions considered? How this amount will be

re-assessed in the future to ensure safe storage and disposal of radioactive waste?

Answer According to the Waste Management Transfer Act responsibility for storage and disposal lies with the Federation. For this purpose, the state-owned company BGZ Gesellschaft für Zwischenlagerung mbH entrusted with the task of operating storage facilities for radioactive waste was founded and became a state-owned company on 1 August 2017 and the federal company for radioactive waste disposal Bundesgesellschaft für Endlagerung mbH (BGE) took over the responsibility as operator of the Asse II mine as well as the Konrad and Morsleben repositories from the Federal Office for Radiation Protection on 25 April 2017. BGZ has been operating the two central storage facilities Ahaus and Gorleben since 1 August 2017. In the next step, the 12 on-site spent fuel storage facilities of the German utilities will be transferred to BGZ on 1 January 2019. One year later the storage facilities for low and intermediate level waste on the NPP sites will follow. In order to ensure an ongoing smooth operation of the storage facilities, the German utilities can be contracted to manage the storage facilities for five years maximum following the shutdown of the nuclear power plant, at the latest by 31 December 2026. According to the Repository Site Selection Act of May 2017, the disposal site for HLW should be determined by 2031. After completion of the licensing procedure and the construction phase, the disposal facility may be commissioned in 2050. Consequently, the responsibility for the storage of radioactive waste will remain with BGZ for several decades.

Under the Act on the Reorganisation of Responsibility in Nuclear Waste Management, the Federation bears all operational and financial responsibilities in relation to the storage and disposal of nuclear waste. The NPP operators remain responsible for the financing and management of decommissioning of the nuclear power plants and the proper packaging of the nuclear waste.

On 3 July 2017, the NPP operators transferred a total of ca. €24.1 billion to a public fund to cover the future costs of the storage and disposal of radioactive waste. The amount consisted of a so called basic amount (ca. €17.93 billion in total) and a risk premium (ca. €6.21 billion in total). By providing the risk premium, the NPP operators terminated their obligation to make any necessary additional payments into the public fund.

The amounts to be paid by the individual NPP operators to the public fund were determined by an audit firm on the basis of the stress test assessing the provisions built by the energy companies to ensure their future payment obligations resulting from the production of electricity from nuclear power. For this purpose, the audit firm assessed the estimates used by the energy companies to calculate the expected future costs arising from the individual waste management steps. The assessment was based on information and data provided by the energy companies, including – inter alia – estimates provided by Federal Authorities and especially by the Federal Office for Radiation Protection. In a next step, the audit firm escalated the estimated costs (in prices of 2014) with a basic inflation rate (1.6 %) and an additional inflation rate considering expected cost increases specifically in the nuclear energy sector (1.97 %). On this basis, the audit firm calculated the future costs to be borne by the individual NPP operators in order to fulfill their future payment obligations in the nuclear energy sector, and discounted these values to calculate the present value (discount rate 4.58 %).

The state facilities which deal with the storage and disposal of radioactive waste prepare annual financial plans regarding the expected costs for future periods. The financial plans take into consideration relevant recent developments that can impact the future costs for the storage and disposal of radioactive waste. Under the Act on the Reorganisation of Responsibility in Nuclear Waste Management, the Federation has to inform the public fund about the estimated costs for storage and disposal that are expected to occur in the upcoming three years. The information is to be provided on an annual basis.

Q.No	Article	Ref. in National Report
*	Article 32	Section A.2 - page 40

Question/ Comment: The salt dome repository at Morsleben has been operated during the period from 1981 to 1998 and since 1998 the Morsleben repository doesn't any more accept radioative waste for low and intermediate-level wastes.

It is indicated in the Section A.2 that for the Morsleben repository "in response to a technical re-evaluation, the BfS irrevocably waived further emplacement. Since the end of emplacement operations, the plan approval procedure for backfilling and closure of the ERAM has been pursued which the BfS had already applied for on 9 May 1993". It is indicated (Annex L, p305/345) that since 2001 no further radioactive waste will be accepted and that closure has been applied for. It is added in the section H6 (p. 250/345) that "this repository is being closed, and the required measures for backfilling and closure are currently being planned."

In the section D3.3 (p. 75/345) it is indicated that "in accordance with the Act on the Reorganisation of the Organisational Structure in the Field of Disposal [1A-30], the operator tasks were transferred to the Bundes-Gesellschaft für Endlagerung mbH (BGE) on 25 April 2017".

Could Germany provide more information about the closure process of the Morsleben repository and the associated planning?

Answer: Following the emplacement stop in September 1998 in the east field due to a court decision, the Federal Office for Radiation Protection irrevocable waived the acceptance and emplacement of further radioactive waste in the ERAM. The original permanent operating license of the ERAM did not include decommissioning measures nor the permit for decommissioning. Since the cessation of the emplacement in 1998 and particularly after the irrevocable waiver of further disposal of radioactive waste in the ERAM, the Federal Office for Radiation Protection initiated the licensing procedure for the closure of the ERAM. The closure concept "extensive filling of mine openings and the sealing of the shafts Bartensleben and Marie as well as the filling of the disposal areas west-south field and east field" was selected from six technical concepts. In total, it is planned to fill in 4 Million m³ of salt concrete as backfill material in the mine openings. As further decommissioning measures, the filling of the two shafts and the isolation of the emplacement fields used for radioactive waste are planned. In a multiple-step, iterative planning process, the closure concept and the related proof of safety were developed. After the first version was prepared in 2005, the Federal Office for Radiation Protection officially submitted the documentation within the plan approval procedure for closure to the competent licensing authority in 2009. A public hearing took place in October 2011. In 2010, the BMU set new safety requirements for the disposal of radioactive waste. Regardless of their scope for heat-generating radioactive waste, these constitute a new regulatory requirement, which was further specified by the SSK for the ERAM in 2011. As a result, the BMU commissioned the German Nuclear Waste Management Commission (ESK) to evaluate the post-closure safety analyses provided by Federal Office for Radiation Protection (BfS) to the licensing authority in 2009 with regard to the changed boundary conditions.

In 2013, the ESK has given 6 recommendations to improve this safety analyses to account for the state-of-the-art as of 2013. BMU has tasked BfS to implement these recommendations into its documentation in the frame of the licensing procedure.

Q.No	Article	Ref. in National Report
*	Article 32	B.1.1 - page 45, D1 - pages 59, 61

Question/ Comment
It is indicated that regarding spent fuel management "as there is as yet no repository available for the spent fuel, it will generally be stored at the sites where it was generated until a repository is commissioned; corresponding storage capacities exist as needed" (p. 45).
In addition, it is indicated (p. 59) that "the spent fuel unloaded from the reactor core is first placed in fuel pools inside the reactor buildings for several years. These pools serve to allow the required decay of activity and heat generation until the fuel is placed in transport and storage casks for storage and provide the operator with sufficient flexibility to operate the facility" and that (p. 61) "On-site storage facilities for spent fuel were licensed under nuclear law and constructed and commissioned at twelve sites with nuclear power plants. They are designed as dry storage facilities in which transport and storage casks loaded with spent fuel are emplaced".
For the management of spent fuel elements, a significant quantity of storage casks will be needed in the near future. The report doesn't provide any forecast about the number of empty casks available for the storage of the spent fuel elements and the additional casks that operators will need in the near future.
Could Germany explain how is managed the suppliance of new dry storage casks that will be necessary to manage and store the spent fuel elements according to planned shutdown of German NPPs? Is there any forecast available (number of casks, handling systems, means for transport, etc)? Is there any risk that the supply chain for casks may be not in a position to cover all the needs in the future?

Answer
All CASTOR-casks intended for German spent fuel storage facilities are manufactured at the manufacturing site at Mülheim. The total manufacturing capacity of 80 casks per year is high enough to meet the strong demand for empty casks triggered by Germany’s decision to phase out nuclear energy by 2022. At the end, about 10.000 Mg heavy metal, representing about 13.000 spent fuel assemblies (SFA) from pressurized water reactors (PWR) and about 17.000 SFA from boiling water reactors (BWR), will be accumulated for dry cask storage in about 1.000 big-sized casks of the CASTOR® V type. By the end of 2016, there were 454 loaded casks so that around 550 casks are still to be loaded. In addition to that, the challenge of achieving the defueled state of shut-down reactors as quickly as possible was associated with a strong increase of cask loading campaigns. The number of staff and equipment had to be increased in order to be able to load casks at several sites simultaneously.
Furthermore, in Germany, a smaller number of big-sized casks out of the TN®-family are in use. Such casks are also available on the market.

Q.No	Article	Ref. in National Report
*	Article 32	A.2, p.39

Question/ Comment
As it is mentioned in the national report, the waste is to be conditioned without delay. Is compatibility (or retrievability) of the conditioned waste with the future disposal facility considered in the selection and implementation of waste treatment and conditioning methods and practices currently applied?

Answer	Primarily, it is reported about radioactive waste with negligible heat generation that has to be disposed of in the Konrad repository. For this repository, the waste acceptance requirements are known. For this reason, the waste can be conditioned without delay. All conditioning methods are aimed at an immobilisation of radionuclides during the operation of a repository and incidents. Further requirements have to be fulfilled by technical barriers (e. g. containers). For HLW, neither a repository nor waste acceptance requirements exist today. Vitrification as the conditioning method is suitable for all relevant host rocks like salt, granite and clay.

Q.No	Article	Ref. in National Report
*	Article 32	B.1.4

Question/ Comment	It is stated in Section B.1.4 that facilities in other European countries are also utilised for waste management. Is there any dedicated regulatory process, guideline or inspection requirements for such waste treatment in other countries?
Answer	For waste management in other European countries, the same rules apply as in Germany. Staff members of the product control of the Bundes-Gesellschaft für Endlagerung mbH (BGE) and their independent technical experts perform controls and inspections on-site when German radioactive waste is conditioned. Also for RW that are conditioned in foreign countries the waste acceptance requirements must be met. For example in Sweden or in France, the experts are regularly involved in the conditioning measures of German RW or in inspections of the conditioning plants.

Q.No	Article	Ref. in National Report
*	Article 32	Figure D-1, p.58

Question/ Comment	When spent fuel or radioactive waste is transported from the generation to the processing, storage or disposal facility, which specific regulations are applied to the transportation and which safety measures and process are required?
Answer	Information on the German regulatory framework for the transport of nuclear fuel and large radiation sources can be found on the web page of the Federal Office for the Safety of Nuclear Waste Management (www.bfe.bund.de/EN/nwm/transports/transports_node.html). Please note that off-site transportation is out of scope of the Joint Convention. The transport regulations concerning transboundary movement apply as described in chapter I of the National Report.

Q.No	Article	Ref. in National Report
*	Article 32	Section B.1.5

Question/ Comment	The report states: “there is no need to differentiate between waste containing radionuclides with comparatively short half-lives and waste containing radionuclides with comparatively long half-lives”. Does it mean that RW containing long half-lives radioisotopes with negligible heat generation can be disposed of with RW containing short half-lives. How long will you carry out the institutional control after closure the repository?

Answer	In Germany, only two waste classes exist. For both classes – heat generating waste and waste with negligible heat generation - deep geological disposal is foreseen. No waste class with shorter half-lives is defined as Germany does not plan near surface disposal. All radioactive waste is to be disposed of in deep geological facilities depending on passive safety. Accordingly, institutional control is no part of the safety case.

Q.No	Article	Ref. in National Report
*	Article 32	D.3.4

Question/ Comment	What is the current status of the process related to trial phase in retrieval of waste from Asse II mine?
Answer	The drillings into and around the emplacement chamber 7 at the 750-meter level are almost finished. At least nine boreholes have been drilled to explore the chamber surroundings and possible cavities at the upper edge of the emplacement chamber. From one borehole into the stope above the emplacement chamber, it was possible to reach a cavity on the top of the drums with radioactive waste. The drums are in different condition. Some are destroyed, some without damage. In the atmosphere, no flammable or explosive gas mixtures were found. The radiological findings are in the expected range. The further drilling into chamber 12/750 is to take place from the existing site at the 750-meter level. Only one borehole in the expected cavity above the drums with radioactive waste is scheduled. The results of the drillings into the emplacement chamber 7/750 show that specific exploration of each sealed chamber with boreholes is necessary immediately before starting retrieval.

Q.No	Article	Ref. in National Report
*	Article 32	B 1.4. – Radioactive waste management pr

Question/ Comment	As described in this report, “Proven methods and reliable mobile or stationary installations” are to be used for treatment and conditioning of radioactive waste. Can you briefly describe if there are any provisions for the so called “problematic waste” generated mainly from reactors decommissioning? What is foreseen for the irradiated graphite?
Answer	All types of solid or solidified radioactive waste with negligible heat generation are intended for disposal in the Konrad repository. The four containers classes designed for disposal at Konrad include the class I with minor requirements, the class II with higher requirements and incident-proof containers of the two classes I and II, respectively. It is foreseen that core components are packed into the so-called cylindrical, cast iron MOSAIK®-casks after dismantling into smaller pieces and drying. Conditioning of ion exchange resins and evaporator concentrate are a further key application of MOSAIK®-casks. The MOSAIK®II-15-cask can be adapted to different activities of the inventory by adding a lead shielding. Radioactive waste that does not meet the acceptance criteria for Konrad, e.g. irradiated graphite due to the large amount of 14C, will be taken into account for the HAW repository according to the Site Selection Act.

Q.No	Article	Ref. in National Report
*	Article 32	Table L-5, p. 296

Question/ Comment: What amount of contaminated metallic residues is annually recycled at CARLA installation? What is the activity of metal after it has been melted?

Answer: The operation of CARLA is licensed for accepting radioactive materials with a specific activity of up to 1,000 Bq/g (alpha, beta, gamma in total). With regard to the beta emitters Fe-55, Ni-63, C-14 and H-3, a total specific activity of 1,000 Bq/ g is allowed additionally. Starting from 100 % metal scrap, usually about 5 % radioactive waste are left over after the melting treatment in the form of secondary waste. The amount of secondary waste is exclusively material dependent and subject to fluctuations. The approximately 5 % radioactive waste is distributed over 3 % slag, 0.8 % furnace linings, 0.7 % dust and 0.5 % rubbish. 95 % of the amount processed can be utilised as far as options are available such as recycling during the production of products for the nuclear sector or utilisation as secondary raw material after unrestricted clearance. The criterion for this is laid down in the Radiation Protection Ordinance § 29(2), Appendix III, Table 1, Column 5 (unrestricted clearance of solid substances and liquids) and 10a (metal debris for recycling).

Q.No	Article	Ref. in National Report
*	Article 32	D.4.2, Table D-9, p. 88

Question/ Comment: Table D-9 presents radionuclide-specific activities of the waste disposed of in the ERAM as at 31 December 2016. Please, indicate what is the radiological capacity of the disposal facility for these radionuclides?

Answer: For the Morsleben repository (ERAM), there are activity limitations only for the radionuclides that are of importance for long-term safety (radiological capacity). These are the following radionuclides:
Alpha-emitters: Activity limits [Bq]
Am-241: 5.3x10E12
Am-243: 5x210E09
Cm-244: 2.1x10E13
Cm-245: 2.0x10E10
Cm-246: 2.0x10E10
Cm-247: 2.7x10E08
Np-237: 5.2x10E09
Pa-231: 3.3x10E09
Pu-239: 1.3x10E11

Pu-240: 1.9x10E12
Pu-242: 4.8x10E09
Ra-226: 1.1x10E11
Th-229: 1.1x10E09
Th-230: 5.2x10E08
Th-232: 3.8x10E09
U-233: 2.6x10E09
U-234: 1.2x10E10
U-235: 9.4x10E09
U-236: 6.2x10E10
U-238: 1.6x10E10

Beta-/Gamma-emitters: Activity limits [Bq]
Ca-41: 8.8x10E11
Cl-36: 3.2x10E12
Cs-135: 3.7x10E11
I-129: 8.3x10E10
Mo-93: 3.0x10E12
Nb-94: 1.3x10E13
Ni-59: 2.0x10E13
Ni-63: 7.3x10E15
Pd-107: 1.7x10E13
Pu-241: 9.4x10E14
Rb-87: 2.2x10E11
Se-79: 7.3x10E10
Sm-151: 7.3x10E14
Sn-126: 3.2x10E10
Tc-99: 5.8x10E12
Zr-93: 4.8x10E11

For the total activity concentration of the alpha emitters there was a restrictive limitation according to the permanent operating licence. It was $4.0 \cdot 10^8$ Bq/m^3.

The other radionuclides listed in Table D-9 result from the safety analyses of normal operation and assumed incidents. For these radionuclides existed limitations for waste packages.
The most restrictive limitations had to be complied with.

Q.No	Article	Ref. in National Report
*	Article 32	B.1.5 p. 48

Question/ Comment: The report states that “in Germany, disposal in deep geological formations is intended for all types of radioactive waste”, including LLW, ILW and HLW. Given that no such facilities are neither operated at the moment nor will become operational until 2050 all the waste has to be held in storage facilities. Are there some plans to amend the requirement on the deep geological disposal of all RW types in accordance with the graded approach discussed in paragraph 1.16 of the IAEA SSR-5 Disposal of Radioactive Waste (“the ability of the chosen disposal system to provide containment of the waste and to isolate it from people and the environment will be commensurate with the hazard potential of the waste”)?

Answer: The disposal facility for heat-generating radioactive waste, which includes the HLW and part of the ILW, will not be available until 2050. However, the Konrad repository site is projected to be completed in 2027 and is designed to accept LLW and most of the ILW. Thus, there is no need seen at this point to change or amend the German disposal concept.

Q.No	Article	Ref. in National Report
*	Article 32	D.1.2 p. 62

Question/ Comment: The Report says that transport casks are used to store SNF in German central storage facilities. Given the proposed SNF disposal strategy and the long-term interim storage period, are there some plans regarding the change-over from this practice to the use of specially designed storage containers?

Answer: Spent fuel is stored in dual purpose casks, which means that the casks are licensed for storage and transportation. The storage has been licensed for a period of 40 years. The casks are stored at reactor sites in storage halls or in centralised storage facilities, also for longer periods of time. At the moment it is not foreseen to change this strategy until a disposal site has been selected and a disposal concept has been developed.

Q.No	Article	Ref. in National Report
*	Article 32	D.5

Question/ Comment: Section D.5 of the Report presents the existing plans for nuclear decommissioning in Germany. Please, elaborate if the terms of the existing decommissioning licenses involve relevant provisions concerning the need of managing the waste resulting from the decommissioning?

Answer: In Germany, the application documents for the decommissioning of nuclear facilities require specifications on waste management. These are, in particular, the description and classification of the radioactive waste types which arise, their conditioning, storage and disposal as well as the measures for radioactive waste reduction. Correspondingly, the decommissioning licence covers waste management.

Q.No	Article	Ref. in National Report
*	Article 32	D.5
Question/ Comment	In which cases during the nuclear decommissioning process it is considered to be not feasible to transfer the resulting waste to a disposal facility?	
Answer	The fact that currently no disposal facility is available until the Konrad repository goes into operation is taken into account by the planning of sufficient storage capacities. The decommissioning waste remains in the storage facilities until it can be transferred to the Konrad repository.	

Q.No	Article	Ref. in National Report
*	Article 32	D.4
Question/ Comment	Please, indicate whether the list of radionuclides monitored during RW control procedure is dependent on the origin of waste?	
Answer	The radionuclides monitored during the product control are not dependent on the origin of radioactive waste. Radioactive waste disposed of in the Morsleben repository or in the Asse II mine had to fulfil the waste acceptance requirements for the repository. Also for the Konrad repository, the radioactive waste packages had to meet the waste acceptance requirements for this repository independent of their origin. The only prerequisite was that the RW must not be high level waste.	

Q.No	Article	Ref. in National Report
*	Article 32	Section D.3.1 / p. 73
Question/ Comment	Concerning the increased demand on capacity for radioactive waste treatment in the next period, is there any plan in Germany to transfer radioactive waste for treatment in facilities in other countries?	
Answer	The transfer of radioactive waste to other countries with the aim of waste processing is allowed for as a viable option in German regulations. Indeed, in the past as well as in the present, German operators have made use of this possibility. However, the responsibility for waste treatment and conditioning still rests with the waste producers, so it is their decision whether, in the future, they want to process radioactive waste abroad or not.	

Q.No	Article	Ref. in National Report
*	Article 32	B.1.5, 49
Question/ Comment	According to chapter B.1.5, the term „radioactive waste with negligible heat production“ has been linked to a maximum temperature increase at the wall of the disposal chamber caused by decay heat from the radionuclides contained in the waste packages must not exceed 3 K on average. It is argued that this value is roughly equivalent to the temperature difference which occurs with a difference in depth of 100 m in a natural temperature environment, and is low compared to the change of temperature caused e.g. by ventilation during. However, no explanation is given, why an increase by 3 K is considered to be safety-relevant. From your comparison above it is evident that the maximum temperature increase is not related to the thermal history the host rock has seen in its geological past (which would define whether a short-term heat input	

would have an effect on the host rock at all. What was the reason to choose such a relatively strict boundary condition, and how do you check, whether the temperature increase criterion will be fulfilled?

Answer

Why is an increase by 3 K considered to be safety relevant?
During the operational phase of the repository, no temperature increases may occur which could have a significant impact on the stability of the mine (thermal load on host rock). On the other hand, the temperature increase must also be limited in the post-operational phase because the calculations of radionuclide mobilisation and transport were carried out without taking into account the temperature dependence of material values and processes.
In order to comply with these boundary conditions, the maximum temperature increase at the walls of the storage chambers is limited beyond the operating phase up to a maximum of 100 000 years to a value of 3 K.
What was the reason to choose such a relatively strict boundary condition?
In the Konrad repository only radioactive waste with negligible heat generation and with a negligible thermal effect on the host rock will be disposed of. The classification of radioactive waste in low active waste (LAW), medium-active waste (MAW) and high-active waste (HAW) does not provide sufficient information on the properties relevant to the disposal of radioactive waste in Germany. Therefore, a categorisation system has been developed under consideration of relevant aspects for disposal, distinguishing between heat-generating radioactive waste and radioactive waste with negligible heat generation which is in compliance with the German disposal requirements.
This waste acceptance requirement is met when the temperature increase at the emplacement room wall due to the decay heat of the radionuclides contained in the radioactive waste does not exceed 3 K. The temperature increase in the Konrad repository must also be limited in the post-operational phase because the calculations for radionuclide propagation were carried out without taking into account the temperature dependence of material values.
How is it checked, whether the temperature increase criterion will be fulfilled?
The heat generation of a radionuclide is a function of the decay energy and the activity. Based on the temperature limitation, activity limits for the waste packages are derived by calculating the heat generation of the specific radionuclides including daughter nuclides (30 reference nuclides and 76 additional nuclides) in the waste packages. Only waste packages meeting these requirements are accepted for disposal. The derived activity values and the resulting heat generation may be exceeded in a waste package if a radial and/or axial heat dilution is applied and the respective summation criterion for the emplacement chamber is met.

Q.No	Article	Ref. in National Report
*	Article 32	D.1.3, 65

Question/ Comment

In chapter D.1.3, it is reported that the storage licence of the AVR cask storage facility in Jülich expired by July 2013. It was extended by issuing temporary orders, but the safety demonstrations with regard to seismic safety could not be provided within the licensing procedure. Consequently, in July 2014, the responsible nuclear supervisory authority gave order to remove the nuclear fuel from the AVR cask storage facility. In July 2016, the storage licence for the Ahaus storage facility was extended to take up the 152 casks with nuclear fuel, but at the time of finalizing the German JC report (August 2017), no transport licence had been granted yet. We resume that for the 152 cask with nuclear fuel,

there has been no save storage for more than 4 years. What mechanisms are provided in Germany to assure that one of the principal purposes of the atomic energy act ("protection of life, health and real assets against the hazards of nuclear energy and the harmful effects of ion-sing radiation") is met and not retarded during years by complex licensing procedures or even contradicting points of interest?

Answer: With its order in pursuant to § 19 Atomic Energy Act (AtG), the nuclear regulatory authority of North Rhine-Westphalia has regulated both the removal of nuclear fuel from the AVR cask storage facility as well as the ownership of the nuclear fuel pursuant to § 5 AtG. Regardless of the formal licensing status, the 152 CASTOR THTR/AVR casks will continue to be safely stored in the AVR cask storage facility even after the temporary licence expires in July 2013. The regulatory content of the storage licence issued by the Federal Office for Radiation Protection (now Federal Office for the Safety of Nuclear Waste Management), which expires in July 2013, will continue to apply. In addition, the operational management continues to be subject to supervision by nuclear regulatory authority of North Rhine-Westphalia which, among other things, continuous monitoring the full operational status by keeping up to date with the in-service inspections of the systems, structures and components of the storage facility by the licensee.

Q.No	Article	Ref. in National Report
*	Article 32	D.3.3, 77

Question/ Comment: In chapter D.3.3, the report informs about the increase in costs for the planning and construction of the Konrad repository. While in the 1980s and 1990s it was assumed that costs of 900 million euros would be incurred for the construction of the Konrad repository, approximately 930 million euros were used for the planning and exploration of the repository and another 1.06 billion euros actual costs were incurred until 2015. The report mentions that the cost estimates by DBE are "considerably higher", but no aggregated costs are listed. Can you explore further on the total costs and what effect these cost estimates had on the total costs for radioactive waste disposal in Germany?

Answer: The total cost for the construction of the Konrad repository is estimated to about 3.6 billion euros. The estimated costs are currently under re-assessment. These numbers contribute to the total costs for radioactive waste disposal in Germany.

Q.No	Article	Ref. in National Report
*	Article 32	D.5.1, 92

Question/ Comment: In the post-operational phase, preparatory work for decommissioning can be carried out.

- How is „preparatory work" defined?
- What activities are allowed?
- What differences are there in practice between the different power plants?

Answer: The post-operational phase can include preparations for removal of the facility, in so far as these are covered by the operating licence or do not represent significant changes (i.e. they can be carried out in accordance with the operating manual as insignificant changes).
Preparatory activities can be for example:

- removal of fuel assemblies or nuclear fuel as early as possible,

- decontamination of the facility and systems,
- taking material samples from systems and components (e.g. for the purpose of a radiological characterisation of the facility) required for the licence application for decommissioning,
- taking inventory of hazardous (e.g. flammable, toxic, water-endangering) substances,
- adaptation of the operating procedures,
- utilisation of radioactive substances and removal of radioactive waste from the operational phase,
- dismantling insulation and taking out of service of systems and installations no longer required, and
- creation of open spaces and of internal transport routes.

The required availability of systems in the post-operational phase is based on the regulations in the operating manual (BHB) for the outage of the nuclear facility. The operator retains the right to apply for further adaptations to longer-term outages, taking particular account of the related nuclear hazard.
The differences in practice are dependent of the individual decommissioning planning of the licence holder. Generally the above mentioned activities are performed during the post operational phase, but there are also plants which are planning decommissioning with fuel assemblies still present in the first decommissioning phase.

Q.No	Article	Ref. in National Report
*	Article 32	B1.1, p.45

Question/ Comment: What is the principle for calculation of allocation to public-law fund for the future costs of storage? What is included in an optional risk premium and for what purposes is it used for? Does NPP provide funds to the Land collecting facilities or to the public-law fund for the future costs of storage?

Answer: The funds provided by the NPP operators consist of a so called basic amount and a risk premium. The NPP operators were obliged to provide the basic amount by law. The basic amount totals to ca. €17.93 billion and will be used to cover the future costs of the storage and disposal of radioactive waste. The NPP operators also had the opportunity to pay a “risk premium”, amounting to a total of ca. €6.21 billion, in order not to be obliged to provide additional capital to the public fund in case of unexpected additional costs in the future.
In return to the payment, the Federation will bear all operational and financial responsibilities in relation to the storage and disposal of nuclear waste. The NPP operators remain responsible for the financing and management of decommissioning of the nuclear power plants and the proper packaging of the nuclear waste.
The basic amount was calculated on the basis of the net present value needed to cover the estimated future costs for the storage and disposal of nuclear waste. The risk premium was provided on top of the basic amount in order to cover future risks and unexpected cost increases. It amounts to 35.47 % of the basic amount.
The basic amount and the risk premium to be provided by the individual NPP operators were determined by an audit firm on the basis of an expert report commissioned by the Federal Ministry for Economic Affairs and Energy to assess the provisions built by the energy companies to

ensure their future payment obligations resulting from the production of electricity from nuclear power, following the “polluter pays” principle.

The audit firm provided its expert report (“stress test”) in October 2015, concluding that the energy companies were in a position to bear the cost of dismantling the nuclear power plants and of packaging and disposing of the nuclear waste. The provisions made for these purposes by the energy companies amounted to a total of €38.3 billion and were based on estimated costs in current prices amounting to around €47.5 billion (calculated as per end of 2014, in prices of 2014). The audit firm confirmed that the estimated costs were plausible and complete and that the provisions had been correctly incorporated into the companies’ balance sheets.

The audit firm conducted its assessment for the stress test as follows:

In a first step, it examined the estimates used by the energy companies to calculate the expected future costs arising from the individual waste management steps – decommissioning and dismantling of the nuclear power plants, packaging, storage and disposal of the nuclear waste. The assessment was based on information and data provided by the energy companies, including – inter alia – estimates provided by Federal Government Authorities and especially by the Federal Office for Radiation Protection. In a next step, the audit firm escalated these costs (in prices of 2014) with a basic inflation rate (1.6%) and an additional inflation rate considering expected cost increases specifically in the nuclear energy sector (1.97%). Finally, future costs to be borne by the individual NPP operators in order to fulfill their future payment obligations in the nuclear energy sector were discounted with a rate amounting to 4.58%.

Considering the findings of the stress test, the audit firm then determined the basic premium to be provided by each NPP operator for the purpose of storage and final repository of nuclear waste. (The responsibility for the financing and management of decommissioning and waste packaging remains with the NPP operators.) To determine the risk premium, the audit firm assessed different future scenarios and possible cost increases and concluded that a risk premium of 35.47% would be reasonable.

The NNP operators transferred the basic amount and the risk premium to the public fund. They did not provide any funds to Land Collecting Facilities under the Act on the Reorganisation of the Responsibility in Nuclear Waste Management.
According to the Atomic Energy Act, NPP operators are not entitled to transfer radioactive waste to Land collecting facilities.

Q.No	Article	Ref. in National Report
*	Article 32	B 1.3, p.46

Question/ Comment: Which criteria are used in the document Stand AG for selection of a site for disposal of heat generating radioactive waste to ensure its safe disposal for one million years?

Answer The criteria are stipulated in the Repository Site Selection Act. The site selection procedure is primarily based on safety related criteria as follows:

Exclusion Criteria, indicating that a region or site is unsuitable for disposal, include thresholds or information on

- Large-scale vertical crustal movements (uplift)
- Active fault zones
- Influences from current or previous mining activities
- Seismic activity
- Volcanic activity
- Groundwater age

Minimum Requirements, which must obligatorily be fulfilled, include thresholds or information on

- Maximal hydraulic permeability of host rock formation
- Minimal thickness of containment-providing rock zone
- Minimal depth of containment-providing rock zone
- Sufficient areal footprint of containment-providing rock zone
- Preservation of the geological barriers over one million years

Weighing or Consideration Criteria, to be used to compare and rank potentially suitable sites, include the comparison of site-specific information concerning:

- Low transport of radioactive substances via groundwater movement and diffusion in the containment-providing rock zone
- Favourable configuration of rock formation, particularly of host rock and the containment-providing rock zone
- Good spatial characterisability
- Good predictability of long-term stability of the favourable conditions (for at least one million years)
- Favourable rock-mechanical preconditions
- Low tendency to the formation of water flow paths in the containment-providing rock zone
- Good conditions to prevent or minimise gas formation from waste under disposal conditions
- Good temperature tolerance of the host rock when receiving thermal energy from the high active waste.
- High radionuclide retention capacity of the rocks within the containment-providing rock zone
- Favourable hydrochemical conditions
- Protective structure of overburden

Supplemental but subordinate to the safety related criteria, planning criteria are to be applied to compare sites that are considered being equal from a safety perspective. Those planning criteria include aspects of general health protection, protection of unique cultural or natural heritage, or locally competing uses and infrastructure.

For a detailed description of the criteria you may also refer to the report of the “Commission on the Storage of High-Level Radioactive Waste”, an English translation of which is available via BMU:
http://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Endlagerprojekte/bericht_kommissionn_lagerung_radioaktiver_abfallstoffe_bf.pdf

Q.No	Article	Ref. in National Report
*	Article 32	B 1.4, p.47

Question/ Comment: What are the mostly wide-spread technologies in Germany which are currently used at nuclear power plants for conditioning of low level and medium level radioactive waste ? What are the reasons of such choice?

Answer: Radioactive waste management technologies need to be distinguished between dismantling and segmentation, decontamination and conditioning of radioactive waste in their radioactive waste package, e.g. a Konrad container. It is assumed that this question is only related to the latter aspect.
The usual procedure for conditioning radioactive waste that has been filled into Konrad containers (either in drums or directly as parts or rubble) is to fill the container with concrete so that all voids are filled and the acceptance criteria of the repository Konrad are met. In order to reduce the weight, special light-weight concrete with a good flowability is used.
Alternatively, dry material such as finely ground building rubble may be used to fill the voids in a Konrad container, if this is compatible with the waste conditioning procedures for a particular type of waste.

Q.No	Article	Ref. in National Report
*	Article 32	B 1.4, p.47

Question/ Comment: Operational radioactive waste at German NPPs is mostly conditioned with mobile facilities. Are such facilities in the property of nuclear power plants? Or shall conditioning services be ordered at the specialized enterprises? If this is the case, then, how are the mobile facilities transported by the national roads of Germany after their use?

Answer: With the gradual shutdown of the German nuclear power plants (NPPs), the need for conditioning of local waste from decommissioning on-site increases while the need for conditioning of operational waste decreases. In order to avoid over-capacities, the stationary facility at Duisburg has not been receiving radioactive waste for conditioning since the end of 2016. If possible, facilities that are no longer required and suitable for mobile use were taken over by NPPs. The transport ban on public roads is limited to spent fuel and therefore does not apply to mobile facilities for waste processing. For transportation, mobile technology is usually packed in 20’ transport containers. Due to the possibility of their internal contamination, these packed containers are licensed as IP-2 packages.

Q.No	Article	Ref. in National Report
*	Article 32	B 1.4, p.47

Question/ Comment: Which types of waste are planned for treatment in Germany and for exporting for treatment to Sweden and other countries?

Answer	Under the new regulations, the responsibility for decontamination, dismantling and demolition of a nuclear power plant remains with the German utilities, whereas the responsibility for storage and disposal lies with the Federation. So, it is the decision of German utilities whether they will be able to process radioactive waste abroad in the future as they did in the past when the four steam generators had been transported from Stade to Sweden. In addition to the steam generators mentioned, the path of waste treatment or waste management via Sweden also includes incineration of mixed waste, metal melting and decay storage of castings. In any case, the option to transport radioactive waste from dismantling into other countries with the aim of processing is still given according to the new German regulations.

Q.No	Article	Ref. in National Report
*	Article 32	B 1.1, p.45

Question/ Comment	What is the reason for the prohibition of reprocessing spent nuclear fuel in Germany after July 1, 2005? Is this for political or technical reasons?
Answer	In 2002, the German Parliament approved an amendment of the Atomic Energy Act that fundamentally altered the Atomic Energy Act of 1959: instead of promoting nuclear energy, its orderly termination is now the purpose of the law. This decision was taken due to a reassessment of the risks associated with the use of nuclear energy. As a preliminary step, an agreement was reached between the Federal Government and the electric power utilities in 2000. Among the key points of the amendment of the Atomic Energy Act, there was the ban on the construction of new commercial nuclear power plants (and reprocessing facilities) and the principle limitation of the normal operating life of the existing nuclear power plants to 32 years. In addition, the Atomic Energy Act amendment included further provisions. The waste management strategy has been limited to direct disposal and the export of spent fuel for reprocessing has been prohibited from 1 July 2005. The operators were also required to build and use storage facilities for spent fuel at the sites of the NPPs. With the prohibition of reprocessing and the decentralised storage of spent fuel, a drastic reduction of nuclear transports had been achieved.

Q.No	Article	Ref. in National Report
*	Article 32	B 1.3, p.46, E 2.2, p.112, K 2, p.278

Question/ Comment	Are there qualitative or numerical criteria for the "best possible safety" option chosen for disposal?
Answer	The criteria are stipulated in the Repository Site Selection Act and some contain numerical values. Finally, the overall assessment, including criteria, preliminary safety analyses, and the environmental impact assessment, will provide the basis for the decision of the site providing the best possible safety.

Q.No	Article	Ref. in National Report
*	Article 32	D 1, p.59

Question/ Comment: The policy of spent fuel management in Germany requires its decentralized storage in many localities. What was the motivation for such a decision: political, technical or social reasons?

Answer: With the amendment of the Atomic Energy Law in Germany, the policy concerning spent fuel management changed. The change comprises, besides the ban of using reprocessing since 2005, also the requirement to store spent fuel until disposal in storage facilities at the NPP sites. The aim of the policy change was to avoid unnecessary transportations of radioactive waste packages and to distribute the burden in a fair way. Therefore, it was consensus that facilities with nuclear electricity production have to store the waste at their site rather than use the central storage facilities. With these decisions, the storage licenses were also limited up to 40 years to demonstrate the public that the storage is a process with a defined end point.

Q.No	Article	Ref. in National Report
*	Article 32	D 1.4, p.66

Question/ Comment: Is there a definition of the term "deep geological formation" in the German nuclear legislation? How is a sufficient "depth" of geological formations justified?

Answer: The term itself is not defined in German legislation, but means disposal in a suitable rock formation sufficiently deep to ensure a clear separation of the wastes from the biosphere. The depth itself is stipulated in the Repository Site Selection Act (§23) as a minimum requirement: The surface of the containment-providing rock zone must be at least 300 metres below the surface of the terrain. In areas with expected deep erosion or deep reaching glacial effects, the surface of the containment-providing rock zone must be deeper than the greatest depth of the expected effects. In areas with rock salt as a potential host formation, thickness of the salt deposit above the containment-providing rock zone must additionally be at least 300 metres thick. In areas with claystone as potential host rock, the overburden has to be sufficiently thick in order to exclude an impairment of the integrity of the claystone by decompaction, even after the occurrence of erosion.

Q.No	Article	Ref. in National Report
*	Article 32	D 3.3, p.78, H 6.3, p.242, J 1.1, p.262

Question/ Comment: The document uses the terms "waste acceptance requirements" and "waste acceptance criteria" in parallel. Do these terms have the same meaning? If not, what is the difference?

Answer: The terms "waste acceptance requirements" and "waste acceptance criteria" have the same meaning.

Q.No	Article	Ref. in National Report
*	Article 32	page 26, Summary

Question/ Comment: Storing all waste in deep geological eliminates the concern for waste segregation, but would be expensive and may not leave enough space for High Level Waste. Please explain reasoning for this strategy.

Answer	In Germany, considerations on the deep geological disposal of all types of radioactive waste date back to the 1950s. Under the general conditions prevailing in Germany, the decision that all types of radioactive waste should be safely disposed of in stable geological formations far from the biosphere has not changed. Of course, concepts for near-surface disposal of low and intermediate level radioactive waste are well known, but due to the early agreement on deep disposal in Germany and the availability of corresponding repository sites, they have never been pursued. The guiding principle for this is the safety of disposal; the necessary costs for this must be borne by the waste producers in accordance with the polluter pays principle. Germany has sufficiently large potential host rock formations from which the best possible location for the disposal of heat-generating radioactive waste will be selected in the current site selection process. The Konrad repository, which is currently being prepared for disposal of up to 303,000 m³ of radioactive waste with negligible heat generation, is not in competition with the disposal of high level radioactive waste in terms of space requirements. In future, there will be an additional need for disposal capacity for low and intermediate level radioactive waste beyond the capacity of the Konrad repository (e.g. waste to be retrieved from the Asse II mine). This waste has to be taken into account in the search for a disposal facility site according to the Repository Site Selection Act.

Q.No	Article	Ref. in National Report
*	Article 32	page 26, summary

Question/ Comment	"The waste originated primarily from research institutions, nuclear power plants and the nuclear industry including reprocessing as well as from medical applications and the non-nuclear industry." What is waste from non-nuclear industry?
Answer	Radioactive waste from non-nuclear industry originates or is produced in radioisotope application in business enterprises and industrial firms. Examples of radioactive waste from non-nuclear industries are contaminated tools and protective clothing, decontamination and cleaning agents, laboratory waste, sealed radioactive sources and debris. This waste is to be disposed of in the Konrad repository.

Q.No	Article	Ref. in National Report
*	Article 32	page 26, Summary

Question/ Comment	Storing all waste in deep geological eliminates the concern for waste segregation, but would be expensive and may not leave enough space for High Level Waste. Please explain reasoning for this strategy.
Answer	In Germany, considerations on the deep geological disposal of all types of radioactive waste date back to the 1950s. Under the general conditions prevailing in Germany, the decision that all types of radioactive waste should be safely disposed of in stable geological formations far from the biosphere has not changed. Of course, concepts for near-surface disposal of low and intermediate level radioactive waste are well known, but due to the early agreement on deep disposal in Germany and the availability of corresponding repository sites, they have never been pursued. The guiding principle for this is the safety of disposal; the necessary costs for this must be borne by the waste producers in accordance with the

polluter pays principle.
Germany has sufficiently large potential host rock formations from which the best possible location for the disposal of heat-generating radioactive waste will be selected in the current site selection process. The Konrad repository, which is currently being prepared for disposal of up to 303,000 m³ of radioactive waste with negligible heat generation, is not in competition with the disposal of high level radioactive waste in terms of space requirements. In future, there will be an additional need for disposal capacity for low and intermediate level radioactive waste beyond the capacity of the Konrad repository (e.g. waste to be retrieved from the Asse II mine). This waste has to be taken into account in the search for a disposal facility site according to the Repository Site Selection Act.

Q.No	Article	Ref. in National Report
*	Article 32.1.1	page 46, B.1.3 And H.3.2

Question/ Comment: Previously Germany has chosen existing mines for disposal of radioactive waste. For the coming site selections; is the aim still to find existing mines or aiming for a certain geology? Are there any preferences or guidelines?

Answer: The forthcoming site selection process will primarily lead to a repository for high level radioactive waste. It is planned to build a tailor-made repository in a suitable geological formation for this purpose. The use of existing mines is not explicitly planned. Areas with existing mines must be avoided, in particular, if mining activities call into question the permeability, integrity and stability of the geological barriers required for disposal.
From a geological point of view, salt rock, clay rock and crystalline rock are considered as potentially suitable repository formations. All three types of rock occur in Germany and will be assessed in the site selection process.
The Repository Site Selection Act is the main guiding document in this context. It specifies, inter alia, a number of exclusion criteria and minimum requirements that a potential repository site must meet. In addition, weighing criteria are used to compare potential sites with each other and to determine a site that provides the best possible safety for disposal.
Further guidance, especially regarding safety requirements and in-depth safety investigations, is to be developed by the competent federal ministry on the basis of an authorisation under the Repository Site Selection Act.

Q.No	Article	Ref. in National Report
*	Article 32.1.1	page 47, B.1.4

Question/ Comment: What are the financial arrangements for disposal of the vitrified waste from the reprocessing in France and United Kingdom?

Answer: The financial arrangements for disposal of vitrified waste from reprocessing in France and the United Kingdom are also included in the fund which was described above. Please refer also to our answer on your question no. 5: “Could Germany provide more detail as to how the sum of around 17 million Euros for the payment by the NPP operators to the fund was established? Also how the additional payments of a risk premium to transfer the interest rate and cost risks to the State is calculated.”

Q.No	Article	Ref. in National Report
*	Article 32.1.3	B.1.3, P46

Question/ Comment: According to the radioactive waste management policy, the operators of nuclear power plants will transfer the radioactive waste storage facilities to a third party commissioned with storage management by the Federation free of charge. Before that, the operators have paid a basic amount and an optional risk premium. What are the standards of the basic amount and the risk premium paid by the operators and how are the value calculated?

Answer: The funds provided by the NPP operators consist of a so called basic amount and a risk premium. The NPP operators were obliged to provide the basic amount by law. The basic amount totals to ca. €17.93 billion and will be used to cover the future costs of the storage and disposal of radioactive waste. The NPP operators also had the opportunity to pay a "risk premium", amounting to a total of ca. €6.21 billion, in order not to be obliged to provide additional capital to the public fund in case of unexpected additional costs in the future.

In return to the payment, the Federation will bear all operational and financial responsibilities in relation to the storage and disposal of nuclear waste. The NPP operators remain responsible for the financing and management of decommissioning of the nuclear power plants and the proper packaging of the nuclear waste.

The basic amount was calculated on the basis of the net present value needed to cover the estimated future costs for the storage and disposal of nuclear waste. The risk premium was provided on top of the basic amount in order to cover future risks and unexpected cost increases. It amounts to 35.47 % of the basic amount.

The basic amount and the risk premium to be provided by the individual NPP operators were determined by an audit firm on the basis of an expert report commissioned by the Federal Ministry for Economic Affairs and Energy to assess the provisions built by the energy companies to ensure their future payment obligations resulting from the production of electricity from nuclear power, following the "polluter pays" principle. The audit firm provided its expert report ("stress test") in October 2015, concluding that the energy companies were in a position to bear the cost of dismantling the nuclear power plants and of packaging and disposing of the nuclear waste. The provisions made for these purposes by the energy companies amounted to a total of €38.3 billion and were based on estimated costs in current prices amounting to around €47.5 billion (calculated as per end of 2014, in prices of 2014). The audit firm confirmed that the estimated costs were plausible and complete and that the provisions had been correctly incorporated into the companies' balance sheets.

The audit firm conducted its assessment for the stress test as follows:

In a first step, it examined the estimates used by the energy companies to calculate the expected future costs arising from the individual waste management steps – decommissioning and dismantling of the nuclear power plants, packaging, storage and disposal of the nuclear waste. The assessment was based on information and data provided by the energy companies, including – inter alia – estimates provided by Federal Government Authorities and especially by the Federal Office for Radiation Protection. In a next step, the audit firm escalated these costs (in prices of 2014) with a basic inflation rate (1.6 %) and an additional inflation rate considering expected cost increases specifically in the nuclear energy sector (1.97 %). Finally, future costs to be borne by the individual NPP operators in order to fulfil their future payment obligations in the nuclear energy sector were discounted with a rate amounting to 4.58 %.

Considering the findings of the stress test, the audit firm then determined the basic premium to be provided by each NPP operator for the purpose of storage and final repository of nuclear waste. (The responsibility for the financing and management of decommissioning and waste packaging remains with the NPP operators.) To determine the risk premium, the audit firm assessed different future scenarios and possible cost increases and concluded that a risk premium of 35.47 % would be reasonable.

Q.No	Article	Ref. in National Report
*	Article 32.1.5	B.1.5 p. 49

Question/ Comment: Germany's criteria used to define radioactive waste differs from that recommended by IAEA' in General Safety Guide GSG-1 "Classification of Radioactive Waste". Could you please provide us examples of the advantages of Germany´s classification criteria compared to IAEA's?

Answer: In Germany, disposal in deep geological formations is intended for all types of radioactive waste. In accordance with the German approach to disposal, the classification of radioactive waste must comply with the requirements for safety assessment of an underground repository. In this respect, the effects of heat generation from radioactive waste on the design and evaluation of a repository system are particularly important, since the natural temperature conditions may be significantly altered by the waste emplaced. In order to meet the requirements concerning the classification of radioactive waste from the point of view of disposal, it has been decided to refrain from using the terms LAW, MAW and HAW and to choose a new classification instead.

Q.No	Article	Ref. in National Report
*	Article 32.2.3	page 81, D.3.4

Question/ Comment: With the experience of having to close Asse II and retrieve the waste are mines still being pursued as an option for radwaste repositories? What was the lesson learned from Asse II problems?

Answer: Today, the very large volume of open drifts and chambers and the closeness of the chambers to the adjoining rock cause the major problem in the Asse II mine. As the mine was used in the past to produce potash salt, numerous chambers were driven in, mostly situated closely on top of each other in the south-western flank. In order to waste as little of the resource as possible, part of the salt was mined immediately up to the adjoining rock, causing an overburden that applies pressure to the mine, pressing the chambers together. Now groundwater enters the mine through clefts that have formed because the salt rock and the adjoining rock loosen.
However, the disposal of radioactive waste in geological formations underground is still considered to be the safest disposal option. According to the Repository Site Selection Act § 1 (4), high active radioactive waste is to be permanently disposed of in a mine specially made for radioactive waste disposal in a suitable host rock deep underground. Negative influences from current or past mining activity are so-called exclusion criteria (§ 22 (2) StandAG) that exclude the possible disposal site from further investigations. The Asse II mine has shown clearly that only cavities that are needed for disposal in combination with a prompt backfilling can guarantee the long-term safety of a repository.

Q.No *	Article	Ref. in National Report
	Article 32.2.4	page 74, D.3.2

Question/ Comment: What fraction of the radwaste stored for decay at NPPs is anticipated to be cleared?

Answer: This question allows no general answer, as decay storage has, on the one hand, the goal to reduce its activity to simplify or optimise the treatment of the radioactive material and, on the other hand, to allow a future clearance of the stored radioactive material. The timeline and conditions for treatment/the amount of material to be cleared depend on the activity level and half-lives of the radioactive material.

Q.No *	Article	Ref. in National Report
	Article 32.2.4	page 83, Table D-5

Question/ Comment: This table shows waste at Konrad, earlier the text indicated that Konrad would not open until 2022. Please explain.

Answer: Table D-5 shows the inventory of radioactive waste as at 31 December 2016 in Germany. The column “Konrad repository” contains masses and volumes of radioactive waste which is planned for disposal in the Konrad repository. This radioactive waste is put in storage, either at the place where it is generated or in a central facility, until it can be disposed of in the Konrad repository. The Konrad repository will not be completed before the year 2027.

Q.No *	Article	Ref. in National Report
	Article 32.2.4	page 98, D.5.6

Question/ Comment: Four Steam Generators were shipped to Sweden for “non-detrimental recycling” what does this term mean?

Answer: Non-detrimental recycling of waste takes place when, given the nature of the waste, the level of contaminants that the waste contains and the type of recovery in question, no impairment of the public interest is expected and, in particular, when no accumulation of harmful substances occurs within the substance cycle (§ 7(3) Law on Closed Cycle Management (KrWG)).

Q.No *	Article	Ref. in National Report
	Article 32.2.5	page 97, D.5.6

Question/ Comment: Why was immediate dismantling chosen versus safe store and what was the cumulative dose using this method?

Answer: Immediate dismantling has been chosen for the Würgassen NPP in order to mitigate social and economic impacts on the employees and the region. Also the site-specific knowledge remains on site by continuing to employ the staff, and it was expected to get an increased acceptance by the authority and the general public for immediate dismantling instead of safe closure.
The cumulative dose from 1997 up to 2014 amounts to 7.5 Sv.