

INTEGRATED REGULATORY REVIEW SERVICE (IRRS)

TO

GERMANY

Bonn, Germany

1 to 12 April 2019

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY



Integrated
Regulatory
Review Service
IRRS



**Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety**



Baden-Württemberg
MINISTRY OF THE ENVIRONMENT, CLIMATE PROTECTION
AND THE ENERGY SECTOR



Schleswig-Holstein
Ministry of Energy,
Agriculture, the Environment,
Nature and Digitalization



**Bavarian State Ministry of the
Environment and Consumer Protection**



**Ministry for the Environment, Climate
Protection, Agriculture and Consumer
Protection**



**Mecklenburg
Vorpommern**
Ministry for the
Interior and Europe



**Ministry for the Environment,
Energy, Building and Climate Protection
of the State of Lower Saxony**

**Ministry of Economic Affairs,
Innovation, Digitalization and Energy of the
State of North Rhine-Westphalia**



**Federal Office
for the Safety of
Nuclear Waste Management**



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Regulatory
Review Service

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Regulatory
Review Service

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**REPORT OF THE
INTEGRATED REGULATORY REVIEW SERVICE (IRRS) MISSION
TO
GERMANY**

Mission dates:	<i>1 - 12 April 2019</i>
Organizations involved:	<i>Federal Ministry for the Environment, Nature Conservation and Nuclear Safety; Baden-Württemberg - Ministry of the Environment, Climate Protection and the Energy Sector; Schleswig-Holstein - Ministry of Energy Agriculture, the Environment, Nature and Digitalization; Bavarian State Ministry of the Environment and Consumer Protection; Hessen - Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection; Mecklenburg Vorpommern - Ministry for the Interior and Europe; Ministry for the Environment, Energy, Building and Climate Protection of the State of Lower Saxony; Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia; Federal Office for the Safety of Nuclear Waste Management; Federal Office for Radiation Protection</i>
Location:	<i>Bonn, GERMANY</i>
Regulated facilities, activities and exposure situations in the scope of the IRRS mission:	<i>Nuclear power plants, research reactors, fuel cycle facilities, waste management facilities, decommissioning, emergency preparedness and response, occupational radiation protection</i>
Organized by:	<i>International Atomic Energy Agency (IAEA)</i>

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The number of recommendations, suggestions and good practices is in no way a measure of the status of the national infrastructure for nuclear and radiation safety. Comparisons of such numbers between IRRS reports from different countries should not be attempted.

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EXECUTIVE SUMMARY

At the request of the Government of Germany, an international team of senior nuclear and radiation safety experts met with representatives of the Government of the Federal Republic of Germany from 1st April to 12th April 2019 to conduct an Integrated Regulatory Review Service (IRRS) mission.

Participating authorities included the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Nukleare Sicherheit (BMU)); the Baden-Wuerttemberg Ministry of the Environment, Climate Protection and the Energy Sector (UMBW); the Schleswig-Holstein Ministry of Energy Agriculture, the Environment, Nature and Digitalization (MELUND); the Bavarian State Ministry of the Environment and Consumer Protection (StMUV); the Hessen Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection (HMUKLV); the Mecklenburg Vorpommern Ministry for the Interior and Europe (IMMV); of Ministry for the Environment, Energy, Building and Climate Protection of the State of Lower Saxony (NMU); the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia (MWIDE); the Federal Office for the Safety of Nuclear Waste Management (Bundesamt für kerntechnische Entsorgungssicherheit (BfE) and the Federal Office for Radiation Protection - Bundesamt für Strahlenschutz (BfS).

The mission took place in Bonn, Germany. The purpose of the IRRS mission was to perform a peer review of Germany's regulatory framework at Federal and Länder level, for nuclear and radiation safety.

The IRRS mission to Germany covered all facilities and activities with the exception of transport, radiation sources, public and medical exposure and the optional module on interfaces with nuclear security. Within this scope, the review compared the German regulatory framework for safety against IAEA safety standards as the international benchmark for safety. The mission was also used to exchange information and experience between the IRRS team members and the German counterparts in the areas covered by the IRRS.

The IRRS team consisted of 17 senior regulatory experts from 16 IAEA Member States, 3 IAEA staff members and 1 IAEA administrative assistant. The IRRS team carried out the review in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities and processes of the regulatory body including authorization, review and assessment, inspection, enforcement and the development and content of regulations and guides; emergency preparedness and response; occupational radiation protection; fuel cycle and radioactive waste management facilities and decommissioning.

The IRRS mission included discussion of two policy issues: regulatory safety culture and maintenance of competence; and informing the public about operational activities and changes at the sites of nuclear facilities.

The IRRS team conducted interviews and discussions with the staff of BMU, BfE, BfS and Länder authorities. Members of the team also observed regulatory inspection activities at operating and decommissioning reactors and radioactive waste management facilities at the Neckarwestheim (GKN) NPP site. The visit also included discussions with the authorized party personnel and management.

In preparation for the IRRS mission, Germany conducted a self assessment and prepared a preliminary action plan to address areas that were identified for improvement. The results of the self-assessment and supporting documentation were provided to the team as advance reference material for the mission. Throughout the mission, the IRRS team was extended full cooperation in the regulatory, technical, and policy issues by all parties in a very open and transparent manner.

The IRRS team acknowledged the outstanding efforts of the participating authorities to engage in this extensive international peer review. The participation by the Länder regulatory authorities enabled the team to develop a broad understanding of the regulatory framework resulting in recommendations and suggestions that should benefit nuclear and radiation safety for all in Germany.

The most significant challenges to Germany relate to facility transitions and human resource management. The challenges for facility transitions include concurrent decommissioning and dismantling of a large number of nuclear power plants, the timely availability of resources and facilities for pre-disposal and management of radioactive waste, retrieval of waste from the Asse II mine and the siting of the disposal facility for heat generating radioactive waste. The human resource challenges include maintenance of competence in the regulatory authorities in light of the changes in regulated activities as well as the maintenance of competence of emergency response organizations following the phase out of nuclear power plants.

The IRRS team identified a good practice that the Federal Government and the Länder, as well as the authorities responsible for disaster control or public safety, have access to relevant information for response to a radiological or nuclear emergency at all times via the Integrated Measurement and Information System. In particular, the information includes a unique Radiological Situation Report to be used by all organizations responsible to take actions in an emergency. This forms a robust basis for a coordinated emergency response. In addition, the team identified several areas of good performance such as:

- Comprehensive legal requirements for scenario-based emergency plans at all levels;
- Knowledge management portal available to all regulatory authorities and their experts;
- Effective coordination between regulatory authorities and prosecution authorities.

The IRRS team made recommendations and suggestions that indicate where improvements are necessary or desirable to continue enhancing the effectiveness of regulatory functions in line with IAEA safety standards. The IRRS team recognized that some of its findings also endorsed the actions identified by Germany as a result of its self-assessment.

The Government should consider establishing a comprehensive plan, in consultation with relevant parties, for the project on German competence and financing needs during future decades.

The Regulatory Authorities should:

- include requirements for addressing public inputs during the process of termination of the decommissioning license;
- complete the establishment and implementation of the BfE integrated management system;
- regularly commission assessments of leadership for safety and of safety culture;
- conduct independent assessments of the management system regularly to evaluate its effectiveness and to identify opportunities for its improvement;
- establish requirements for the periodic review and update of safety assessments during immediate dismantling;
- develop a comprehensive inspection programme for FRM II research reactor by specifying inspection items, frequency for inspections and provisions for announced, unannounced and reactive inspections in accordance with the graded approach.

The IRRS team also found some areas for improvement related to further elaborating guidance: for using a graded approach for the supervision of research reactors; for disposal of radioactive waste with negligible heat generation; to address interdependences with other facilities when implementing dismantling projects; and for decommissioning of facilities which are regulated under the Radiation Protection Act.

Finally, the IRRS team identified several areas where further guidance would be helpful in managing the changes needed throughout the coming transitions to sustain the relevance of the regulatory framework and to support efficient and consistent application across several regulatory authorities.

The IRRS team findings are summarized in Appendix IV.

An IAEA press release was issued at the end of the IRRS Mission.

I. INTRODUCTION

At the request of the Government of the Federal Republic of Germany, an international team of senior safety experts met representatives of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Nukleare Sicherheit (BMU)); of the Baden-Wuerttemberg Ministry of the Environment, Climate Protection and the Energy Sector (UMBW); of the Schleswig-Holstein Ministry of Energy Agriculture, the Environment, Nature and Digitalization (MELUND); of the Bavarian State Ministry of the Environment and Consumer Protection (StMUV); of the Hessen Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection (HMUKLV); of the Mecklenburg Vorpommern Ministry for the Interior and Europe (IMMV); of the Ministry for the Environment, Energy, Building and Climate Protection of the State of Lower Saxony (NMU); of the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia (MWIDE); and of the Federal Office for the Safety of Nuclear Waste Management (Bundesamt für kerntechnische Entsorgungssicherheit (BfE)), Federal Office for Radiation Protection (Bundesamt für Strahlenschutz (BfS)) - during the period from 1st April to 12th April 2019 to conduct an Integrated Regulatory Review Service (IRRS) mission.

The purpose of this IRRS peer review mission was to review the German regulatory framework for nuclear and radiation safety. The review mission was formally requested by the Government of Federal Republic of Germany in June 2017. A preparatory meeting was conducted from 25th to the 26th September 2018 at the BMU Headquarters in Bonn to discuss the purpose, objectives and detailed preparations for the review in connection with the regulated facilities and activities in Germany and their related safety aspects and to agree the scope of the IRRS mission.

The IRRS review team consisted of 17 senior regulatory experts from 16 IAEA Member States, 3 IAEA staff members and 1 IAEA administrative assistant. The IRRS review team carried out the review in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities and processes of the regulatory body including authorization, review and assessment, inspection, enforcement and the development and content of regulations and guides; emergency preparedness and response; occupational radiation protection; fuel cycle and radioactive waste management facilities and decommissioning. In addition, two policy issues were discussed: (1) Regulatory safety culture and maintenance of competence, and (2) Informing the public about operational activities and changes at the sites of nuclear facilities.

The Federal and Länder authorities conducted a self assessment in preparation for the mission and presented a preliminary action plan. The results of the self-assessment and supporting documentation were provided to the IRRS review team as advance reference material for the mission. During the mission, the IRRS review team performed a systematic review of all topics within the agreed scope of the review, through review of the advance reference material, conducting interviews with management and staff from the participating Federal and Länder authorities, and by direct observation of regulatory inspections for the operating Nuclear Power Plant (NPP) and decommissioning and radioactive waste management facilities and activities at the Neckarwestheim (GKN) site.

A meeting with Ms. Svenja Schulze (Federal Minister for Environment, Nature Conservation and Nuclear Safety) and Mr. Helmfried Meinel (Director General at the Ministry of the Environment, Climate Protection and the Energy Sector Baden-Wuerttemberg) was held in Berlin. The IRRS team also held a meeting with the representatives of two Technical Support Organizations (TSO): GRS (Gesellschaft für Anlagen- und Reaktorsicherheit gGmbH) and TÜV (Technischer Überwachungsverein).

Throughout the mission, the IRRS team received excellent support and cooperation from all of the German counterparts.

II. OBJECTIVE AND SCOPE

The purpose of this IRRS mission was to review the nuclear and radiation safety regulatory framework in Germany against the relevant IAEA Safety Standards, to report on regulatory effectiveness and to exchange information and experience in the areas covered by the IRRS. The agreed scope of this IRRS peer review included all facilities and activities regulated in Germany with the exception of transport, radiation sources, public and medical exposure and the optional module on interfaces with nuclear security. It is expected that this IRRS mission will facilitate regulatory improvements in Germany and other Member States, utilising the knowledge gained and experiences shared between Germany and the IRRS reviewers, and the evaluation of the Germany regulatory framework for nuclear safety, including areas of good practices and good performance.

The key objectives of this mission were to enhance the national legal, governmental and regulatory framework for nuclear and radiation safety, and national arrangements for emergency preparedness and response through:

- a) providing an opportunity for continuous improvement of the national regulatory body through an integrated process of self-assessment and review;
- b) providing the host country (Government and Regulatory authorities) with a review of regulatory technical and policy issues;
- c) providing the host country (Government and regulatory authorities) with an objective evaluation of its regulatory infrastructure with respect to IAEA Safety Standards;
- d) promoting the sharing of experience and exchange of lessons learned among senior regulators;
- e) providing key staff in the host country with an opportunity to discuss regulatory practices with IRRS Review Team members who have experience of other regulatory practices in the same field;
- f) providing the host country with recommendations and suggestions for improvement;
- g) providing other states with information regarding good practices identified in the course of the review;
- h) providing reviewers from Member States and IAEA staff with opportunities to observe different approaches to regulatory oversight and to broaden knowledge in their own field (mutual learning process);
- i) contributing to the harmonization of regulatory approaches among states;
- j) promoting the application of IAEA Safety Requirements; and
- k) providing feedback on the use and application IAEA Safety Standards.

III. BASIS FOR THE REVIEW

A) PREPARATORY WORK AND IAEA REVIEW TEAM

At the request of the Government of Germany, a preparatory meeting for the Integrated Regulatory Review Service (IRRS) was conducted from 25 to 26 September 2018. The preparatory meeting was carried out by the appointed Team Leader, Mr. Daniel Dorman, Deputy Team Leader, Ms Lydie Evrard, and the IRRS IAEA Team representatives, Mr. Zia H. Shah, Team Coordinator, Mr David G. Bennett, Deputy Team Coordinator, and the German Counterparts.

The IRRS mission preparatory team had discussions regarding regulatory programmes and policy issues with the senior management of BMU represented by Dr. Wolfgang Cloosters, Director General BMU, other senior management and staff. It was agreed that the regulatory framework with respect to the following facilities and activities would be reviewed during the IRRS mission in terms of compliance with the applicable IAEA safety requirements and compatibility with the respective safety guides:

- Nuclear power plants
- Research reactors
- Fuel cycle facilities
- Radioactive waste management
- Decommissioning
- Emergency preparedness and response
- Occupational radiation protection

Presentations were made by the national counterparts on the national context, the current status of regulatory infrastructure in Germany and the self-assessment results.

IAEA staff presented the IRRS principles, process and methodology. This was followed by a discussion on the work plan for the implementation of the IRRS mission to Germany in April 2019.

The proposed composition of the IRRS Review team was discussed and tentatively confirmed. Logistics including meeting and work places, counterparts and Liaison Officer identification, proposed site visits, lodging and transportation arrangements were also addressed.

The Germany Liaison Officers for the IRRS mission were confirmed as Mr. Thomas Elsner and Mr. Kai Weidenbrück, BMU.

Germany provided IAEA with the advance reference material (ARM) for the review at the end of January 2019. In preparation for the IRRS mission, the IAEA review team members reviewed the advance reference material and provided their initial impressions to the IAEA Team Coordinator prior to the commencement of the IRRS mission.

B) REFERENCES FOR THE REVIEW

The relevant IAEA Safety Standards and the Code of Conduct on the Safety of Research Reactors were used as the basis for the review. The complete list of IAEA publications used as the references for this mission is provided in Appendix VI.

C) CONDUCT OF THE REVIEW

The initial IRRS Review team meeting took place on Sunday 31st March 2019 in Bonn, Germany, directed by the IRRS team Leader and the IRRS IAEA Team Coordinator. Discussions encompassed the general overview, the scope and specific issues of the mission, clarified the basis for the review and the background, context and objectives of the IRRS programme. The understanding of the methodology for review was

reinforced. The agenda for the mission was presented to the review team. As required by the IRRS Guidelines, the reviewers presented their initial impressions of the ARM and highlighted potentially significant issues to be addressed during the mission.

The host Liaison Officers were present at the initial IRRS Review team meeting, in accordance with the IRRS Guidelines, and presented logistical arrangements planned for the mission.

The IRRS entrance meeting was held on Monday 01 April 2019, with the participation of Dr. Wolfgang Cloosters, Director General BMU, senior management and staff from the Baden-Wuerttemberg Ministry of the Environment, Climate Protection and the Energy Sector; the Schleswig-Holstein Ministry of Energy Agriculture, the Environment, Nature and Digitalization; the Bavarian State Ministry of the Environment and Consumer Protection; the Hessen Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection; the Mecklenburg Vorpommern Ministry for the Interior and Europe; the Ministry for the Environment, Energy, Building and Climate Protection of the State of Lower Saxony; the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia; and the Federal Office for the Safety of Nuclear Waste Management. Opening remarks were made by Dr. Wolfgang Cloosters, IRRS team Leader, Mr. Daniel Dorman and Mr. David M. Senior, Section Head of the Regulatory Activities Section IAEA. Mr. Thomas Elsner, Liaison Officer Germany, gave an overview of the German regulatory framework, the results of German self assessment, and the action plan prepared as a result of the pre-mission self-assessment.

During the IRRS mission, a review was conducted for all review areas within the agreed scope with the objective of providing Germany with recommendations and suggestions for improvement and where appropriate, identifying good practices. The review was conducted through meetings, interviews and discussions, visits to facilities and direct observations regarding the national legal, governmental and regulatory framework for safety.

The IRRS review team performed its review according to the mission programme given in Appendix II.

The IRRS exit meeting was held on Friday, 12th April, 2019. The opening remarks at the exit meeting were presented by Dr. Wolfgang Cloosters and were followed by the presentation of the results of the mission by the IRRS team Leader Mr. Daniel Dorman. Closing remarks were made by Juan Carlos Lentijo, Deputy Director General, Department of Nuclear Safety and Security, IAEA.

An IAEA press release was issued.

1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT

1.1. NATIONAL POLICY AND STRATEGY FOR SAFETY

Germany is a country with a long-standing radiation protection and nuclear safety legal system. Additionally, as a member of the European Union Germany is obliged to implement European Council Directives on nuclear safety, on radiation protection, and on the safety of spent fuel management and radioactive waste management. Key legislation and subordinate regulations lay down the basic principles for safety.

The coalition agreement of the present government contains a section on atomic energy policy (Atompolitik) where government is committed to maintain best possible safety to the plants which remain in operation until the end of 2022 at the latest and to provide for decommissioning and waste management. The government also stresses its commitment to maintain Germany participation to international conventions and relevant instruments also after the shutdown of the NPPs. The government also announces a plan for the maintenance of safety competence for nuclear facilities and waste management. This plan will cover the competence and financial needs in coming decades for both national activities and international co-operation of all relevant interested parties such as federal and Länder regulators, operators, TSOs, research institutes, education, etc.

The national strategy for safety is further elaborated by the Federal Ministry for the Environment, Nature conservation, and Nuclear Safety (BMU). The “Strategic Plan for the Directorate General S” was issued in 2017. It contains guiding principles, mission, vision, and strategic objectives of the directorate. This document is an internal document of BMU and it can be amended by BMU decision. It deals inter alia with the staffing and competences of the General Directorate S itself not Germany as a whole.

The government’s national strategy for the responsible and safe management of spent fuel and radioactive waste is laid down in “Programme for the responsible and safe management of spent fuel and radioactive waste (National Programme)” issued by BMU (as required by the EU Directive 2011/70/Euratom of 19 July 2011). The national programme is subject to potential revision on the basis of the suggestions of the German parliament's Commission on Storage of High-Level Radioactive Waste, which was set up pursuant to Section 3 of the Site Selection Act. There are two important statements showing committed of the government into a safe waste management:

- “The management of radioactive waste shall as a rule be carried out within German national responsibility.”
- “Disposal facilities are to be established at two sites: the Konrad disposal facility for radioactive waste with negligible heat generation and a disposal facility according to the Site Selection Act especially for heat-generating radioactive waste.”

Immediate dismantling is the decommissioning strategy of choice as stipulated in the Atomic Energy Act. In the ARM is further stated that the goal of decommissioning is a “green field”.

The Atomic Energy Act (§7c (2)) requires licensees to establish a management system with due priority being given to nuclear safety. Leadership for safety and safety culture are included in the fundamental principles and organizational requirements for NPPs (Safety requirements for NPPs).

The principle of following a graded approach to safety is laid down in the Basic Law. Application of the graded approach in regulatory oversight is required in the Radiation Protection Act (§180 (1)). The Atomic Energy Act (§2d (4), 12b (3)) states that a graded approach shall be applied in waste management and security respectively. The graded approach is also considered in the Atomic Energy Act (e.g. §6, §7) with respect to licensing different types of nuclear installations.

1.2. ESTABLISHMENT OF A FRAMEWORK FOR SAFETY

The Basic Law divides the legislative powers and the execution of federal laws between the Federation and the Länder. The Federation has legislative power (Basic Law clause 14 of Art. 73(1)). This means that laws dealing with matters of nuclear safety and radiation protection are federal laws. Their execution, on the other hand, is divided between the Federation and the Länder. As a consequence, there are authorities in charge of nuclear safety and radiation protection at both federal level and Länder level.

According to the Basic Law, the Federal Chancellor determines the competence of the supreme federal authorities by decree. Accordingly, responsibility for the safety of nuclear installations and radiation protection was transferred to the BMU. The Basic Law has, thus, assigned the legislative power for the peaceful use of nuclear energy to the Federation. As part of the Federal Government, the BMU is involved in legislation (legislative power), while the Länder implement the Atomic Energy Act on behalf of the BMU (federal executive administration). BfE fulfils tasks assigned by the Atomic Energy Act in its role as a subordinated authority of the BMU in the area of safety of nuclear waste management.

The Basic Law was last reviewed and amended in 2019.

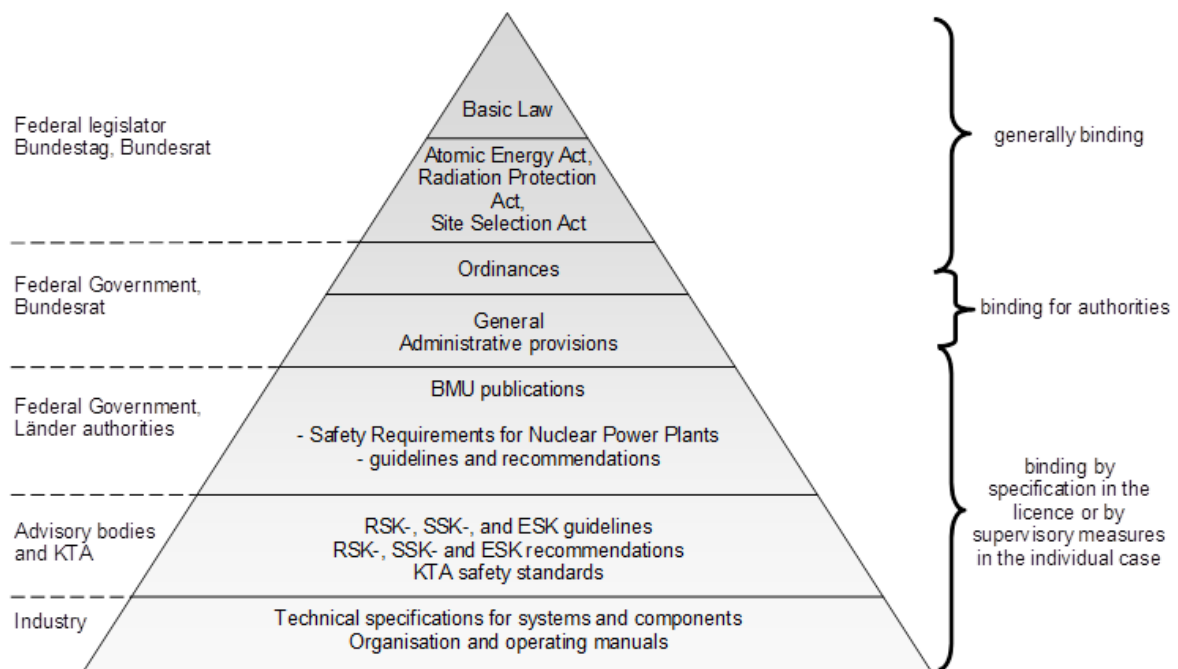


Fig. 1 - German regulatory pyramid

Fig.1 represents the hierarchy of the national legislation, rules and regulations in Germany, the authority or institution issuing them, and the extent to which they are binding for the authorities and the operators of nuclear installations.

Atomic Energy Act

The Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards (Atomic Energy Act) was promulgated on 23 December 1959, and subsequently amended and promulgated a number of times, the last amendment being on 10th July 2018. This Atomic Energy Act covers all types of nuclear facilities and activities, including waste storage facilities and disposal facilities.

With the amendment of the Atomic Energy Act of 6th August 2011 (13th Atomic Energy Act amendment), further operation of eight nuclear installations for electricity generation (power operation) was terminated, whereas additional dates for the latest possible termination of power operation were fixed for the remaining nine nuclear installations. The latest amendments specify that the remaining German NPPs will shut down by the end of the year 2022 and cover the implementation of EU directives and the re-organization of arrangements for waste management.

Article 7 specifies that no further licenses will be issued for the construction and operation of nuclear power plants. It identifies that there is a continuing licensing activity for operation and possible modifications of existing nuclear power plants.

The Atomic Energy Act addresses in different articles several issues like: the prime responsibility for safety of the licensee, the requirement for continuous improvement of safety and the use of state-of-the-art of science and technology, licensing and supervisory powers of the competent authorities, periodic safety reviews obligation, obligations of the competent authorities and the licensee in relation to communication to the public, the responsibilities of BMU for self-assessment and international verification of the legal, executional and organisational framework for safety,

Article 58 of the Atomic Energy Act describes the transition of responsibilities for licensing of nuclear waste storage facilities from the Länder to BfE.

Radiation Protection Act

The use of radioactive sources is regulated in the Radiation Protection Act. The new Radiation Protection Act was issued on the 27th June 2017 and is based on the European directive 2013/59/Euratom (Basic Standards Directive) which provides the framework for radiation protection within the EU. The scope of the Act covers planned exposure situations, emergency exposure situations and existing exposure situations. The exposure categories defined in the Act are public exposure, occupational exposure and medical exposure.

Site Selection Act

The purpose of the Act on the Search and Selection of a Site for a Disposal Facility for Heat-Generating Radioactive Waste (Site Selection Act (Standortauswahlgesetz (StandAG))), which was amended in year 2017, is to specify a site selection process for disposal of heat generating radioactive waste in Germany. Through this process, the site with the best possible safety for a period of one million years is to be identified for a facility for the disposal of heat generating radioactive waste.

In 2016 the Act on the Re-Structuring of Responsibilities in Radioactive Waste Management was enacted following a recommendation of the parliamentary commission established in 2013 according to the first version of the Site Selection Act considering the separation of the supervision of waste management activities from operation activities. This involved the establishment of a licensing and supervisory authority (BfE) and an operator (BGE) for waste management. The Site Selection Act includes, among other things, criteria for the site for the disposal facility for heat generating radioactive waste, following the recommendation of the parliamentary commission established in 2013. The procedure for site selection process is expected to be terminated in 2031 and the disposal facility to be commissioned around the year 2050.

Site Selection Act Article 19 (1) states that “The Federal Office for the Safety of Nuclear Waste Management (BfE) shall examine the proposal of the project delivery organisation including the underlying site comparison of at least two sites. Based on the result of this assessment and taking into account all private and public interests as well as the results of public participation, the Federal Office for the Safety of Nuclear Waste Management shall assess which is the site with the best possible safety”.

Site Selection Act Article 19 (2) states that “The Federal Office for the Safety of Nuclear Waste Management shall submit the reasoned site proposal including all necessary documents to the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.”

In the Site Selection Act there are no requirements concerning organization and management of the project delivery organization carrying out the site selections process. The high-quality results of the site exploration are cornerstone of the site selection and related safety assessment. Further this data forms the basis for the coming licensing activities of the final disposal facility. The Site Selection Act has provision for BfE to impose obligations to the project delivery organisation (BGE).

Ordinances

On the basis of the Atomic Energy Act, Radiation Protection Act and Site Selection Act ordinances can be issued. These ordinances generally require approval by the Bundesrat and thereafter become binding legislation once published in the Federal Law Gazette. At the time of IAEA IRRS mission ordinances were in place based on the Atomic Energy Act and Radiation Protection Act. Ordinances based on Site Selection Act are under development.

General administrative provisions

General administrative provisions can be issued, based either directly on the Basic Law or on authorizations included in ordinances. Such administrative provisions regulate the actions of the authorities and are binding for the authorities addressed therein. For third persons, they have an indirect effect since they are considered in the administrative decisions. General administrative provisions exist relevant to radiation protection and environmental issues.

BMU publications

The BMU releases publications, after consultation with the Länder as appropriate, in the form of requirements, directives, guidelines, criteria and recommendations (such as the Safety Requirements for Nuclear Power Plants) listed in Appendix V. BMU publications describe the view of the federal nuclear licensing and supervisory authority and, if the relevant decisions have been taken in the LAA, also the view of the Länder nuclear licensing and oversight authorities with respect to general nuclear safety issues. They provide guidance to the Länder nuclear licensing and oversight authorities in connection with the execution of the Atomic Energy Act. This procedure also helps consistent execution of licensing and oversight in the different Länder. These publications have no binding legal status unless incorporated in either the nuclear plant license or other oversight measure. In order to identify potentially required changes to the national regulations, the requirements are reviewed regularly (every five years) to ensure that they are up to date.

Other publications

Advisory bodies, such as the Reactor Safety Commission (RSK), or the Nuclear Safety Standards Committee (KTA), or the industry itself, produce publications in the form of guidance, recommendations, standards or specifications. These documents, as for the BMU publications, have no binding legal status unless incorporated in either the license or other oversight measure.

Maintenance of the framework for safety

The acts and ordinances are updated on demand or on the basis of regulatory or operating experience. The Safety Requirements for Nuclear Power Plants and KTA standards are at least reviewed every 5 years. At the time of IRRS mission the KTA standards are intended for NPPs. The future of the KTA is discussed in the KTA commission. There is common understanding that KTA will continue to be needed after the year 2022. The topic is discussed further in Module 9.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *There are no requirements concerning organization and management of the project delivery organization (BGE) carrying out the site selection process.*

(1)	<p>BASIS: GSR Part 1 Requirement 2, para. 2.5 (6) states that <i>“The government shall promulgate laws and statutes to make provision for an effective governmental, legal and regulatory framework for safety. This framework for safety shall set out the following:</i></p> <p>...</p> <p><i>(6) Provision for assigning legal responsibility for safety to the persons or organizations responsible for the facilities and activities, and for ensuring the continuity of responsibility where activities are carried out by several persons or organizations successively;”</i></p>
(2)	<p>BASIS: SSR 5 Requirement 25, para. 5.22 states that <i>“An appropriate management system that integrates quality assurance programmes will contribute to confidence that the relevant requirements and criteria for site selection and evaluation, design, construction, operation, closure and safety after closure are met. The relevant activities, systems and components have to be identified on the basis of the results of systematic safety assessment. The level of attention assigned to each aspect has to be commensurate with its importance to safety. The management system is required to comply with the relevant IAEA Safety Standards on management systems [13, 14].”</i></p>
S1	<p>Suggestion: BfE should consider requiring the project delivery organization (BGE) to have adequate organizational requirements including a management system to ensure high quality of site selection process, site assessment and confidence for future activities.</p>

1.3. ESTABLISHMENT OF A REGULATORY BODY AND ITS INDEPENDENCE

BMU, BfE and Länder together form the German regulatory authority on the basis of national laws. BfE and Länder are authorized by Atomic Energy Act to grant licenses and verify compliance of the license holders with the licensing requirements.

The financial resources at federal and Länder level are allocated by the annual budget plans. The budget plans allocate the financial resources which the licensing and oversight authorities in charge of nuclear safety and radiation protection needs for the fulfilment of their tasks. They include the annual expenditure, for example for the appointment of authorised experts pursuant to § 20 Atomic Energy Act.

BMU and the Länder authority are both headed by the Ministers of their respective Ministries; these Ministries do not have responsibilities for the promotion of nuclear energy. The Ministers have other responsibilities in addition to nuclear safety, but not conflicting with it.

BfE is, by the Site Selection Act charged with the supervision of the site selection process and with the task of submitting to BMU reasoned recommendations on the proposals of the project delivery organisation for the siting regions to be explored from the surface (§15(2)) and for the sites to be explored underground (§17(2)). Finally, BfE shall examine the proposal of the project delivery organisation including the underlying site comparison of at least two sites. Based on the result of this assessment and taking into

account all private and public interests as well as the results of public participation, BfE shall assess which is the site with the best possible safety (§19(1)). BfE shall submit the reasoned site proposal to BMU (§19(2)).

The German host explained that, as stipulated by the Site Selection Act, the highest consideration for BfE is the safety of the site and therefore they consider there is no conflict with the IAEA standards. However, at the moment of the mission there were no sub statutory instructions how these tasks should be performed.

The requirements of the Act appear to indicate BfE is tasked with advising not only on matters relating to safety (as required by the IAEA standards) and with taking an active role in the site selection process. This might later impair its independence in the licensing of the facility.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
<p>Observation: <i>Under the Site Selection Act Article 19 BfE is required to examine the proposal of BGE including the underlying site comparison of at least two sites taking into account all private and public interests as well as the results of public participation, BfE shall assess which is the site with the best possible safety.</i></p> <p><i>The responsibility for BfE to submit a reasoned proposal for siting and take account of interests other than safety, might compromise or conflict with the responsibility of BfE for regulating the safety of facilities and activities.</i></p>	
(1)	<p>BASIS: GSR Part 1 Requirement 4, para. 2.9 states that “No responsibilities shall be assigned to the regulatory body that might compromise or conflict with its discharging of its responsibility for regulating the safety of facilities and activities.”</p>
S2	<p>Suggestion: BMU should consider making clear in the regulatory framework how the Site Selection Act will be implemented in a manner that will not compromise or conflict with BfE discharging its responsibility for regulating the safety of facilities and activities.</p>

1.4. RESPONSIBILITY FOR SAFETY AND COMPLIANCE WITH REGULATIONS

Atomic Energy Act Article 7c (1) and Radiation Protection Act, Article 70 Section 1 and Article 72 specify that the responsibility for safety lies with the license holder. The responsibility of the license holder of a nuclear installation cannot be delegated to any other person; if - under the Radiation Protection Act - the license holder has appointed a radiation protection supervisor; the license holder remains responsible even though also the radiation protection supervisor is responsible for compliance with the duties incumbent upon him. The responsibility of the license holder also extends to activities of contractors and subcontractors which could impair the nuclear safety of the license holder’s installation. Furthermore, the license holder of a nuclear installation is also the person responsible for radiation protection according to § 69 Radiation Protection Act.

1.5. COORDINATION OF AUTHORITIES WITH RESPONSIBILITIES FOR SAFETY WITHIN THE REGULATORY FRAMEWORK

Germany's Regulatory Authority is structured to reflect the national federal system, with the federal component provided by the Directorate-General S (Subdirectorates Safety of Nuclear Installations, Subdirectorates Radiological Protection and Subdirectorates Nuclear Waste Management) within the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The federal structure and the 16 federal states in Germany are laid down in the Basic Law. The responsibilities at the federal and Länder level are shown below.

Key Regulatory Functions	Federal Level	Länder Level
Development of Guides and Regulations	Responsible	Participating
Regulatory Research	Responsible	Participating
International Cooperation	Responsible	Participating
Authorisation / Licensing	Supervising*	Responsible
Review and Assessment	Supervising	Responsible
Inspection and Enforcement	Supervising	Responsible
* Exceptions exist for: spent fuel storage facilities, existing disposal projects, the site selection process for a disposal for high level radioactive waste and for future disposal sites		

Fig. 2 - Distribution of responsibility between the Federation and Länder.

The essential processes of supervision of the Federation and the Länder as well as their interfaces in connection with the safety of nuclear power plants are described in a Handbook on Cooperation between the Federation and the Länder in Nuclear Law (the Handbook). At the time of IRRS mission the Handbook covers processes dealing with licensing and oversight of NPPs. The Handbook does not consider the regulatory tasks of BfE.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *The scope of the Handbook does not cover all regulated facilities and activities and regulatory functions. Also, BfE is not reflected in the Handbook (for example, coordination of the transition of licensing of the disposal facility for radioactive waste with negligible heat generation from the Land authority to BfE at commissioning is not included).*

(1)

BASIS: GSR Part 1 Requirement 7, states that “Where several authorities have responsibilities for safety within the regulatory framework for safety, the government shall make provision for the effective coordination of their regulatory functions, to avoid any omissions or undue duplication and to avoid conflicting requirements being placed on authorized parties.”

S3

Suggestion: BMU should consider extending the Handbook in order to cover all regulated facilities and activities and regulatory functions as well as all parts of the regulatory authority.

1.6. SYSTEM FOR PROTECTIVE ACTIONS TO REDUCE EXISTING OR UNREGULATED RADIATION RISKS

The Radiation Protection Ordinance (§167, §168, §169) regulate, on the basis of a statutory authorisation according to Article 173 of the Radiation Protection Act, reporting to the radiation protection supervisory authority of unregulated radioactive sources. Once the competent authority has become aware of the above-mentioned circumstances, it takes the necessary measures to protect the population and affected employees. Depending on the urgency, the competent authority takes the necessary measures in the context of an emergency exposure situation or an existing exposure situation, e.g. after the discovery of a radioactively contaminated site. If it is possible to identify a responsible person in an existing exposure situation, the competent authority may require him/her to take the necessary measures.

1.7. PROVISIONS FOR THE DECOMMISSIONING OF FACILITIES AND THE MANAGEMENT OF RADIOACTIVE WASTE AND OF SPENT FUEL

The elements of the German decommissioning policy are implemented into the legal and regulatory framework:

- regarding decommissioning, the ARM states that for NPPs “Direct dismantling is the decommissioning strategy of choice with the final goal of a ‘green field’”. The Atomic Energy Act stipulates the shutdown of German NPPs. For Fuel Cycle Facilities and Research Reactors, and also for waste management facilities, either immediate or deferred dismantling strategy can be implemented.
- regarding waste management, the Atomic Energy Act requires that “the national waste management programme shall include [...] the national inventory of all spent fuel and radioactive waste and estimates for future quantities, including those from the decommissioning of facilities and installations”.

The Atomic Energy Act as amended aims, among other things, at the immediate decommissioning and dismantling of nuclear power plants whose authorisation for power operation expired or whose power operation has ceased permanently. For NPPs, complete dismantling up to the point of building demolition has to be achieved, with partial release of the site in those cases where there will be on-site storage facilities for spent nuclear fuel and radioactive waste. This situation will create an “interim state” for the site where the remaining interim storage facilities will be regulated under a separate license until the availability of a disposal facility.

Sixteen NPPs were shut down before 2011 and some of them have been in the decommissioning stage for long time periods. The status and the progress of these decommissioning projects are not detailed in the ARM, but some of them have been in decommissioning for almost 30 years. For the 17 NPPs ceasing operation after 2011, it has been indicated that their decommissioning projects are planned to last for ~15 years. The German context is such that it can be observed that there are two main groups of NPP decommissioning projects; the first starting in the 1990s, and a second starting after 2011 in the period to 2022. By 2023, therefore, there will be approximately 30 power reactors undergoing decommissioning.

In addition, a significant number of Research Reactors are also under post operation or under decommissioning (around 10).

The main objective of the German approach is to prioritize the dismantling of the NPPs with the aim of decommissioning all NPPs by 2045.

To achieve these overall objectives, the German regulatory framework addresses provision of sufficient storage capacity for spent fuel and other radioactive waste on site. In some cases, NPP operators transfer radioactive waste for storage on other NPP sites. There is thus some strategic planning of radioactive waste management above site level. It is the responsibility of the licensees undertaking decommissioning to

estimate the amounts of waste and manage their interactions with BGZ on storage, and for BGZ to manage its interactions with BGE for disposal.

Strategic planning of these interdependences at a national level could be beneficial for such a large programme of decommissioning.

1.8. COMPETENCE FOR SAFETY

Education in nuclear and radiation safety is provided by German universities and state educational institutes. In addition to the professional education offered by the public institutes, the nuclear power plant operators founded the so-called “Power Plant School” in 1957 to accommodate the needs for power plant staff. Officially recognised radiation protection courses are run at both university and non-university institutes. They establish quality standards for radiation protection courses in their Association of radiation protection training facilities (Qualitätsverbund Strahlenschutzkursstätten (QSK)). There are several research reactors in operation in Germany.

In order to maintain the necessary expertise in the areas of nuclear technology and radiation protection, the Alliance for Competence in Nuclear Technology of German research institutes was founded in March 2000. In association with the Energy Research unit of the Helmholtz Association of German Research Centres (HGF), this brings together the research facilities in the area of nuclear safety. The Alliance for Competence in Nuclear Technology is established to coordinate tasks in the area of reactor safety and radioactive waste disposal research and contributes to maintaining the competence through analysing the training situation and future staffing needs. Participating Helmholtz Centres are: Forschungszentrum Jülich, Helmholtz-Zentrum Dresden-Rossendorf and Karlsruhe Institute of Technology.

Technical support is provided to BMU by several technical support organizations (TSO)., These are, e.g. the Gesellschaft für Anlagen - und Reaktorsicherheit (GRS) gGmbH, Brenk Systemplanung GmbH, Physikerbüro Bremen and Öko-Institut e.V. For nuclear waste management, the BfE uses a wider range of expert organisations such as the TÜV and the Bundesanstalt für Materialforschung und –prüfung (BAM) as well as other TSOs. The nuclear supervisory authorities of the Länder contract the major technical expert organisations of the TÜVs (TÜV = Technical Inspection Association, German: Technischer Überwachungsverein, i.e. TÜV Nord, TÜV Süd and TÜV Rheinland). As a rule, framework agreements exist between the nuclear licensing and supervisory authorities of the Länder and the TÜVs, which oblige TÜVs to perform certain tasks in the long term and to provide the necessary know-how including appropriately qualified personnel.

BMU has an annual research budget of million 32 euro for nuclear and radiation safety research. The annual budget for research of BfE is 3 million euro. BMU contracts the research with TSO organizations and other research organizations such as universities. While BfE itself contracts research, it also has its own research programme carried out by BfE experts. The Länder have their own research budget.

In line with the coalition agreement, BMU has started a project on German competence and financing needs for future decades. The project is run in co-operation with ministries of industry (BMWi) and education (BMBF). The IRRS team was informed that the project is very comprehensive and will provide a picture of the needs of the regulatory authority, the operators, the TSO's, universities and trading organisations, in the fields of nuclear safety, radiation protection, emergency preparedness, and radioactive waste management. An overall project plan was not available to the IRRS team but the first draft of a report on competence needs is due in the year 2020.

Involvement of all parties (regulatory authorities, other ministries etc.) is of great importance. A survey of the needs, in terms of staffing and financial resources of all relevant parties, should be available by 2022, in order to favour coordinated and safe activities during the phase out.

The regulatory authority, BMU, has identified in the Action Plan the need to review the regulatory authority competences and undertake training to reflect the changing operating environment in the field of nuclear safety, radiological protection and radioactive waste management.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>BMU has initiated a project on competence and financing needs during future decades. A comprehensive plan (including resources, milestones, planning, deliverables etc.) for this project is not available. In the ARM action plan this topic is partially addressed.</i>	
(1)	BASIS: GSR Part 1 Requirement 11, para. 2.34 states that “ <i>As an essential element of the national policy and strategy for safety, the necessary professional training for maintaining the competence of a sufficient number of suitably qualified and experienced staff shall be made available</i> ”
(2)	BASIS: GSR Part 1 Requirement 18, para. 4.13 states that “ <i>A process shall be established to develop and maintain the necessary competence and skills of staff of the regulatory body, as an element of knowledge management. This process shall include the development of a specific training programme on the basis of an analysis of the necessary competence and skills. The training programme shall cover principles, concepts and technological aspects, as well as the procedures followed by the regulatory body for assessing applications for authorization, for inspecting facilities and activities, and for enforcing regulatory requirements</i> ”
S4	Suggestion: The Government should consider establishing a comprehensive plan, in consultation with relevant parties, for the project on German competence and financing needs during future decades.

1.9. PROVISION OF TECHNICAL SERVICES

Monitoring services for the assessment of occupational exposure due to external or internal exposure during work, exposure of emergency workers, exposure due to radon in workplaces and exposures due to other existing exposure situations, including radiological relevant legacy sites, are recognized by the competent authorities of the Länder (§169 of the Radiation Protection Act). Currently, 4 monitoring services for external exposure, 26 for incorporation and 3 for radon monitoring have been recognized. Additionally, two calculation programmes for cosmic radiation have been recognized by the Federal Aviation Office (LBA).

The same article of the Radiation Protection Act also sets the necessary conditions to be recognized, among which having sufficient personnel, the necessary procedures and equipment and an appropriate quality management system. Following verification of the application file submitted by the monitoring service, proving that it fulfils the requirements, the competent authority formalizes the recognition through an administrative act.

This article also sets the requirements on recording and communication of assessment results. Further details on how to comply with these and other conditions and obligations are given in BMU guidelines. These guidelines, dating from 2001 for external exposure and 2007 for internal exposure, are being revised in the light of the new Radiation Protection Act and Ordinance.

For dose assessment of aircrew, the aviation companies calculate the doses using algorithms which are authorized by the Federal Aviation Office (§ 67 (3) of the Radiation Protection Ordinance). The calculated dose data are sent to the Federal Aviation Office which transfers these to the national dose register.

BfS organises inter-comparisons for internal monitoring services, offers quality assurance for dosimetry, measurement of radon, radioactivity in the environment and for some of the IMIS measurements and provides scientific support to the Federal Aviation Office in the authorization process (§ 185 (1) Nr. 5 of the Radiation Protection Act). BfS also provides lots of information to the monitoring services via its website and information meetings.

The Physikalisch-Technische Bundesanstalt (PTB), the metrology and calibration institute, offers quality assurance for external dosimetry. It is the national calibration laboratory for radiation measurements.

1.10. SUMMARY

Germany is a country with a long-standing radiation protection and nuclear safety legal system. Additionally, as a member of the European Union Germany is obliged to implement European Council Directives on nuclear safety, on radiation protection, and on the safety of spent fuel management and radioactive waste management. Key legislation and subordinate regulations lay down the basic principles for safety. The responsibilities and functions of the government and of the different parts of the regulatory authority are described in the Basic Law, several acts, and subordinate regulations.

The present system can be strengthened to better address the coming challenges related to the phase out of nuclear energy production and the necessary overview at the federal level of the upcoming activities, needs and their interdependences related to the phase out.

The IRRS team suggests that the federal authorities clarify and further develop the framework for implementing the Site Selection Act.

1.11. POLICY ISSUE DISCUSSION

Maintenance of competence

The phase-out of the commercial use of nuclear energy in Germany will lead to a shift in the tasks and priorities of many authorities and technical support organisations towards decommissioning and dismantling, storage, and eventually to disposal. Germany strives to contribute also in future to the further development of safety requirements and regulations at the international level and to continue fulfilling its responsibility. However, this can only be achieved with the necessary expertise. Competences in decommissioning and dismantling as well as in questions of disposal should, therefore, be maintained and expanded. Transformation from the active use of nuclear energy and towards decommissioning and dismantling, storage and eventually disposal must be integrated into the future concept developments. These processes are complex, and it will only become clear in practice how they can be steered jointly, i.e. by the Federal Government, its subordinate agencies, the Länder, the licensees, and the technical support organisations. There is a clear intention that maintaining competence and adjusting the emphasis in the areas of decommissioning and disposal will be a key element in near future. This applies not only to national needs but may also extend to international context in terms of German contributions to improving nuclear safety in countries close to its borders and worldwide.

The IRRS team shared various models and mechanisms used by different countries to maintain optimum level of competence in the regulatory authorities through policies and strategies of recruitment, trainings and incentives. The IRRS team also shared their respective policies, strategies, resources and practices which include recruitments of young staff with different educational background in engineering and physical sciences, providing focused training and on the job training by working on rotation in various

regulatory processes such as inspection, review and assessment as well as various regulated activities such as nuclear power plants, research reactors, fuel facilities and decommissioning. The IRRS team highlighted the importance of sustainability in policy for maintaining competence within the regulatory authorities especially in a context like Germany's where some of the regulated activities are in a significant state of transition. This is applicable at federal and Länder level and their respective technical support organizations so that the phase out of nuclear power program is regulated effectively in ensuring nuclear and radiation safety.

Regulatory safety culture (supervisory culture)

At the important juncture of nuclear phaseout, maintaining and promoting safety culture beyond the operating time of the nuclear power plants is important to the authorities in Germany as the decommissioning and dismantling of the nuclear power plants as well as other nuclear installations continue to be subject to state supervision, whereby the protection of public and the environment remains an overriding priority. It is therefore, important that the process which is initiated towards a common understanding of regulatory safety culture of the nuclear authorities in Germany is to be continued in view of promoting and strengthening safety culture across all authorities as well as within each individual authority. This necessitates that suitable methods for self-reflection and self-assessment of the regulatory safety culture and measures for its promotion and improvement need to be evolved based on international experience feedback.

During the discussion, the IRRS team shared various approaches and methodologies of self-assessment of safety culture and leadership for safety within the regulatory authorities. Responsibility and commitment of senior management ensures that an independent assessment of leadership for safety and of safety culture is regularly carried out and that the results of that assessment and the identification of corrective actions to continuously improve the safety culture of the regulatory body are communicated at all levels in the organization. The IRRS team shared various approaches and activities for enhancing safety culture in line with the results of self-assessment results which include enhancing learning, information sharing, openness, transparency and accountability within the organization. IAEA has also initiated various activities related to safety culture and leadership for safety. Germany is encouraged to benefit from related IAEA activities.

Public Communication

In addition to the specified form of public participation in nuclear licensing procedures, the nuclear rules and regulations contain requirements for the information of the public by the licensee and the authority concerning the specified normal operation of the nuclear facilities as well as reportable events and accidents. The local population as well as the stakeholders in the vicinity of a nuclear facility are to be given special consideration. Different communication formats (internet, informative events, etc.) are used for this purpose. In addition to these formal procedures, the nuclear authorities in Germany endeavour to regularly inform the general public in the vicinity of nuclear facilities about safety aspects of operations and of changes in the nuclear power plants. Experience shows that interest is generally rather low as long as no significant events occur. To inform the public about the decommissioning of a nuclear power plant, communication formats such as information committees, public debates, etc. are used in particular. In addition to safety-related issues connected in particular with the topics of interim storage and disposal of radioactive waste, any changes in the site locality affecting the economy, the labour market and everyday life in the region could also be addressed. These topics are considered to be part of the information provided to the public and the public information need to be developed further. An involvement of experts and the interested public with respect to the preparation of prolonged interim storage has been initiated by the competent licensing authority.

The IRRS team shared the experience on various ways and means of public communications in respective countries which include sharing information on the regulatory decision-making process, involvement in

regulatory decision making by seeking public opinion at important milestones of decision making such as site licensing, life extension, major design modification approvals, decommissioning and waste management approvals. It was discussed that the regulatory authorities should target the focus groups within the affected communities and media. It was also discussed that transparency in regulatory decision-making process enhances the credibility of the regulatory body as an effective decision-making entity focused on the safety of people and the environment.

2. THE GLOBAL SAFETY REGIME

2.1. INTERNATIONAL OBLIGATIONS AND ARRANGEMENTS FOR INTERNATIONAL COOPERATION

Germany ratified a number of international conventions, which have been implemented in national law. The most relevant within the context of this review are the Convention on Nuclear Safety (CNS), the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (JC), and the Convention on Early Notification of a Nuclear Accident. Germany submits reports and participates in the peer review process of these conventions.

Germany is represented in international organisations at a global level, such as the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA) within the Organisation for Economic Co-operation and Development (OECD). Germany participates in the committees for the development of the IAEA Safety Standards.

At European level, Germany is a member of ENSREG (European Nuclear Safety Regulators Group), WENRA (Western European Nuclear Regulators Association) and HERCA (Heads of the European Radiological Protection Competent Authorities).

Additionally, Germany has concluded bilateral agreements with eight of its nine neighbouring countries for the exchange of information about nuclear installations close to borders and emergency preparedness and response.

Germany contributes actively to the worldwide improvement of nuclear safety by conveying its safety-related findings through participation of German experts in all bodies at international level. This is achieved mostly through representatives from the supreme federal authorities. Staff from the licensing and supervisory authorities of the Federation and the Länder often have expertise and experience that would be of great interest internationally.

Participation of Germany in international activities is mainly achieved through representatives from the BMU, and to a lesser extent from the BfE, the BfS, the Länder, and TSOs (mainly GRS and TÜV). The IRRS team was informed that more active participation of staff from the licensing and supervisory authorities of the Federation and the Länder is foreseen. This would make it possible to better contribute internationally with the entire range of German expertise. However, at present there is no general plan to coordinate and enhance international involvement of the different parts of the regulatory authorities and TSOs. Increased participation of German experts in international activities would also improve the regulatory experience feedback mechanism in Germany.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *Participation of Germany in international activities is mainly achieved through representatives from the BMU, and to a lesser extent from the BfE, the BfS, and the Länder. This has been partially recognized in the ARM and is part of the Action Plan.*

(1)

BASIS: GSR Part 1 Requirement 14, states that “The government shall fulfil its respective international obligations, participate in the relevant international arrangements, including international peer reviews, and promote international cooperation and assistance to enhance safety globally.”

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(2)	BASIS: GSR Part 1 Requirement 15, states that <i>“The regulatory body shall make arrangements for analysis to be carried out to identify lessons to be learned from operating experience and regulatory experience, including experience in other States, and for the dissemination of the lessons learned and for their use by authorized parties, the regulatory body and other relevant authorities.”</i>
S5	Suggestion: The BMU should consider increasing international participation and involvement of staff from BfE, BfS and Länder to improve the regulatory experience and feedback to Germany and to the international community.

2.2. SHARING OF OPERATING EXPERIENCE AND REGULATORY EXPERIENCE

The nuclear licensing and supervisory authorities have implemented effective procedures in order to gather, process, evaluate and share safety-relevant operating experience from German nuclear installations. In addition, corresponding processes have been included in the “Handbook on Cooperation between the Federation and the Länder in Nuclear Law”.

In Germany, reportable events are systematically recorded and evaluated by the licensees of nuclear facilities (see Nuclear Safety Officer and Reporting Ordinance). The licensing and supervisory authorities, together with the expert organisations, maintain appropriate databases for the systematic recording and assessment of reportable events.

German expertise and operating practice are discussed at international level within the framework of international working groups, bilateral working meetings and commissions. Events occurring in German nuclear facilities are presented to the relevant IAEA and OECD/NEA bodies, such as the Working Group on Operating Experience (WGOE) and are reported to the International Reporting System for operating experience (IRS), the Incident Reporting System for Research Reactors (IRSRR), or the Fuel Incident Notification and Analysis System (FINAS).

The Handbook also contains a process description for regulatory experience feedback such as implementation of IAEA Safety Standards or of WENRA Reference Levels. However, a stronger, direct participation of licensing and supervision authorities would enhance the regulatory experience feedback process. See Suggestion in Chapter 2.1

2.3. SUMMARY

The IRRS team acknowledges that Germany has a high level of international involvement. The IRRS team concluded, that the German regulatory authority fulfils the international obligations by participating in the relevant international fora, and in international peer reviews. International involvement is presently mainly achieved through representatives from the BMU.

Effective procedures for operational and regulatory experience feedback are in place and corresponding processes are described in the “Handbook on Cooperation between the Federation and the Länder in Nuclear Law”.

The IAEA IRRS mission team suggests considering more active direct participation and involvement of all licensing and supervisory authorities of the Federation and the Länder in the fulfilment of international duties.

3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY

3.1. ORGANIZATIONAL STRUCTURE OF THE REGULATORY BODY AND ALLOCATION OF RESOURCES

The division of responsibilities between the Federal regulator, the BMU, and the regulatory authorities of the Länder is codified in law, between the Basic Law and the Atomic Energy Act.

The BMU has overall responsibility for drafting and implementing legislation, the development of guides and regulations, regulatory research and driving international cooperation. The Länder execute the Atomic Energy Act and its ordinances. In doing this, the Länder are subject to Federal oversight as to the legality and expediency of execution. BMU can issue binding instructions to the Länder on the conduct of their supervisory tasks. BMU only makes use of this option in exceptional cases and as a last resort: the last binding instructions were issued in 2009.

The BMU's Directorate-General S "Nuclear Safety, Radiation Protection" is a federal nuclear authority. It comprises three Directorates. Directorate S I performs tasks in the field of safety of nuclear facilities. Directorate S II deals with radiation protection tasks, including the topic of emergency preparedness and response. Directorate S III performs tasks with respect to the nuclear waste management (nuclear supply and disposal).

The licensing and supervisory authorities for nuclear facilities are ministries of the Land in which the facility is located.

The BfE was established in 2014 as the central licensing and supervisory authority in the field of waste management. Its activities started in 2016. It is the licensing authority for storage facilities for high-level radioactive waste and the licensing and supervisory authority for repositories. The BfE also has tasks in the site selection procedure aimed at establishing a repository for high-level radioactive waste and organizes public participation in the site selection process. The BfE also supports the BMU by providing its expertise in the field of nuclear safety.

The subordinate authority of the BMU in the area of radiation protection is the BfS. Two technical departments of the BfS deal with the statutory tasks in the areas of "Radiation Protection and Environment" and "Radiation Protection and Health". This includes, in particular, the effects and risks of ionising and non-ionising radiation, medical and occupational radiation protection, monitoring of environmental radioactivity as well as emergency preparedness and response.

The relevant authorities and offices are established by means of organisational decrees or by laws (such as the BfE or BfS) and are endowed with the powers necessary for nuclear licensing and supervision. They are then provided with financial resources by means of the adoption of the financial budget in the parliaments. The Atomic Energy Act and the Cost Ordinance to the Atomic Energy Act provide for the fees to be charged by the authority for its supervisory activities and the granting of licenses. Staffing is the responsibility of the individual authorities

3.2. EFFECTIVE INDEPENDENCE IN THE PERFORMANCE OF REGULATORY FUNCTIONS

The effective independence of the regulatory authorities is determined by the constitutional principle in the Basic Law, in ordinary law through the Atomic Energy Act and the ordinances issued thereunder. Issues related to the Site Selection Act are addressed in Module 1, Section 1.3. The constitutional principle enshrined in the Basic Law ensures that the regulatory body is able to perform its functions free from undue influence and is therefore a key element for ensuring that the decision-making process of the regulatory authority is based on nuclear safety considerations only.

In addition, the federal and Länder authorities in charge of nuclear safety and radiation protection are functionally separated from all other governmental bodies and organisations that deal with matters related to the use or promotion of nuclear energy, such as for electricity generation. The principle of separation is another key element to ensure the effective independence of the regulatory body in all matters of nuclear safety.

At federal level, the functional separation is ensured by an organisational decree of the Federal Chancellor pursuant to the Basic Law. The Federal Chancellor has designated the BMU as the competent highest federal authority for nuclear safety and for radiation protection. In contrast to this, the Federal Chancellor has assigned responsibility for the use or promotion of nuclear energy, such as for electricity generation, to other ministries in order to ensure the effective independence of the BMU from any undue influence in its regulatory activities. The Ministries responsible for energy matters cannot instruct the BMU and vice versa. This ensures that safety-related decisions cannot be affected by any conflicts of interest.

Functional separation is also ensured at Länder level, through an ordinance issued by the government of the respective Land. Through organisational arrangements, the Länder ensure that the licensing and supervisory authorities in charge of nuclear safety and radiation protection are functionally separated from all other governmental bodies and organisations that as part of the overall energy policy or energy industry promotion deal with matters that are related to the use or promotion of nuclear energy such as for electricity generation.

The effective independence of the federal and Länder licensing and supervisory authorities is further strengthened by the power of the BMU, within the scope of the Basic Law to issue binding instructions to the Länder authorities on the execution of the law. Should, in a specific case, the BMU and a Land authority have different views as to the execution of provisions of the Atomic Energy Act or the ordinances issued thereunder, the BMU has the power to make the ultimate decision on the subject matter.

In cases where the Federation executes the Atomic Energy Act and the ordinances issued thereunder through its own administrative authorities, such as the BfE or the BfS, the BMU as the competent highest federal authority for nuclear safety and radiation exercises oversight as to the legality and expediency of execution. Should in a specific case the BfE or the BfS and the BMU have different views to the execution of a law, the BMU has the power to make the ultimate decision on the matter and may instruct the BfE or BfS on how to execute the law. The BMU's authority to issue instructions again ensures independent safety-related decision-making.

3.3. STAFFING AND COMPETENCE OF THE REGULATORY BODY

The licensing and supervisory authorities in charge of nuclear safety and radiation protection are provided with the competence and the resources necessary to fulfil their statutory obligation for the regulatory control. Overall, the Federal authorities and the Länder authorities generally have a sufficient number of qualified and competent staff, commensurate with the nature and number of facilities and activities to be regulated. The licensing and supervisory authorities are given the necessary financial resources to fulfil their statutory obligation for the regulatory control.

The financial resources at federal and Länder level are allocated by the annual budget plans, needed for the fulfilment of their tasks. At both the Federal and Länder level, there is a political commitment to nuclear safety, and this has resulted in the governments always providing the resources requested by the regulatory authorities.

At both the Federal and Länder level, the prerequisite for specialist staff at the regulatory authorities is a relevant university-level degree. New staff are trained in skills for special tasks (specialist nuclear

knowledge, administration.) – if required – in an introductory phase through courses and through practical collaboration within the authorities.

Although the staff of the BMU and BfE are generally technically competent, both organizations do not have many qualified engineers. Most staff qualifications are in law and natural sciences. The IRRS team was informed that, since the issues to be dealt with by the BMU and by some organisational units at the BfE are abstract from specific technological solutions and practical operational aspects, they might be perceived to be less attractive to engineers. In addition, the IRRS team was informed that due to lower pay than in the private sector, engineers prefer working for the industry. The lack of engineering qualifications at the Federal authorities is partially compensated by experience gained by staff coming from the TSOs. However, the lack of engineers could have implications for the analytical culture of the BMU and BfE. At the Länder level, there are generally sufficient staff with engineering qualifications, as there are more opportunities to have applied and operational working experience. Therefore, in combination with working conditions that often are more flexible than in the industry, Länder regulators can attract engineers more easily than the Federal authorities.

The competent authority for Baden-Württemberg has a detailed planning for the staff needed in order to fulfil the tasks of the authority commensurate with the radiation risks. This planning takes into consideration when NPPs enter a new state, e.g. from operation to post-operation or from post-operation to decommissioning. This planning currently covers the time until 2025 and predicts a certain reduction in staff needs due to the end of NPP power operation, and the transition to shut-down and decommissioning.

Potential losses of experience during the generation change within the federal nuclear authority have so far been largely compensated by documentation of knowledge, surveys and the commitment of the younger staff. The Länder nuclear licensing and supervisory authorities also face particular challenges in maintaining their competence. Special efforts continue to be required to maintain the necessary staffing levels and to ensure that younger staff is trained in good time.

The BMU has grown substantially since the last IRRS mission in 2008. This reflects the strong political commitment to providing resources for safety. When taken together with the newly created BfE and the resources of the BfS, the staffing at the federal level is growing in spite of the ongoing phasing out of nuclear power. The BMU intends to strengthen its resources for the assessment of NPPs in long-term operation in neighbouring countries. It also intends keeping NPP specific knowledge after completion of the phase-out in Germany.

The TSOs working for the Länder authorities envision a substantial decrease of staffing in the near future as nuclear power is phased out in Germany. This, however, is not the case for GRS, the TSO that is working on the federal level. The BMU explained that Germany wishes to maintain competence in nuclear power operation due to neighbouring countries operating NPPs, and a desire for Germany to continue to have globally recognised expertise in the field. This is also stated in the coalition agreement of the present Government.

At both the Federal and Länder level, newly recruited staff members take part in the knowledge transfer of the nuclear licensing and supervisory authorities. They receive training on the basis of individual plans. Each individual on-the-job training plan comprises different training and further qualification measures, the introduction to special fields of work and guidance for independent acting. Depending on the intended area of work and already available knowledge, junior staff are trained in all relevant technical and legal areas.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *Key elements of the Federal authorities have a limited number of qualified staff with engineering expertise.*

(1)	BASIS: GSR Part 1 Requirement 18, states that <i>“The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities.”</i>
(2)	BASIS: GSG-12, para. 6.4 states that <i>“In addition to depending on the employment of sufficient staff with suitable qualifications and expertise, the effectiveness of the regulatory body will also depend on the status of its staff in comparison with those of the authorized parties and other involved organizations. Staff of the regulatory body should be appointed at such grades and with such salaries and conditions of service as would facilitate their interactions with authorized parties and reinforce the independence and authority of the regulatory body staff in conducting their work.”</i>
(3)	BASIS: GSR Part 1 Requirement 20, para 4.22 states that <i>“The obtaining of advice and assistance does not relieve the regulatory body of its assigned responsibilities. The regulatory body shall have adequate core competence to make informed decisions. In making decisions, the regulatory body shall have the necessary means to assess advice provided by advisory bodies and information submitted by authorized parties and applicants.”</i>
S6	Suggestion: The Federal authorities should consider measures to ensure there is a sufficient number of qualified staff with engineering expertise.

3.4. LIAISON WITH ADVISORY BODIES AND SUPPORT ORGANIZATIONS

The regulatory authorities of the Federal level and the Länder have access to dedicated technical support organizations (TSOs). At the Federal level, the BMU relies on the external expertise of several technical expert organisations. These are the Gesellschaft für Anlagen- und Reaktorsicherheit GmbH (GRS), the Physikerbüro Bremen and the Öko-Institut e.V.

The primary TSO used by the BMU is the GRS. It is a private, non-profit company and not a subordinated authority of the BMU. The GRS is a scientific and research institution, independent of economic interests and committed to the common public interest. The GRS supports the BMU in many technical questions in the field of reactor safety and conducts research projects on the safety of nuclear facilities.

The BfE has access to a wide range of TSOs including the Technical Inspection Association (TÜV) for technical advice on licensing procedures for the storage of spent fuel elements in storage and transport casks. The BfE can also use the technical advice of the Federal Institute for Materials Research and Testing. This is an expert organisation that is able to both perform calculations on the mechanical stability of the casks and practical tests on casks.

The Länder may consult experts to assist their licensing and supervisory activities. The TÜVs provide general technical expertise, but also other technical expert organisations or individual experts with specific

knowledge on particular topics. Framework agreements exist between the nuclear supervisory authorities of the Länder and the TÜV, which oblige the TÜV to perform certain tasks in the long term and to provide the necessary know-how including appropriately qualified personnel. This ensures that the relevant TÜV is almost permanently present in the nuclear facility, carrying out individual inspections and test activities. The various activities performed over a longer period of time allows the technical expert organisation to build up qualified knowledge of the entire installation.

The Federal and Länder regulatory authorities have access to several advisory bodies. These are the Reactor Safety Commission (RSK), the Commission on Radiological Protection (SSK) and the Waste Management Commission (ESK). The RSK provides support in matters of nuclear safety and security. The SSK provides support on matters of protection against ionizing and non-ionizing radiation. The ESK provides support on nuclear disposal issues (conditioning, storage and transport of radioactive material and waste, decommissioning and dismantling of nuclear facilities, final disposal in deep geological formations). The members of these commissions are independent, qualified for the tasks and reflect the range of technical-scientific opinions. According to the commissions' statutes, the members are committed not to receive instructions from external parties, and to express neutral and scientifically plausible opinions. The members of the commissions are appointed by the BMU, and there are robust processes in place for preserving the integrity of the appointments. The focus of their activities is primarily on providing support and advice on issues of fundamental importance and initiating further safety-related developments. The results of the consultations are published in the form of general recommendations and statements concerning individual issues.

The BMU and the Länder have demonstrated that they make effective use of the advisory bodies and external experts to support regulatory functions. The BMU has leveraged this capability on complex technical analyses, while maintaining the ultimate decision-making authority and the necessary competency to operate as an intelligent customer.

3.5. LIAISON BETWEEN THE REGULATORY BODY AND AUTHORIZED PARTIES

The Länder authorities and relevant Federal authorities have established formal and informal mechanisms of communication with the licensees on all safety-related issues. The responsibilities for regulatory tasks and thus also for the relevant communication with the licensees are regulated in the Atomic Energy Act.

The Länder are responsible for communicating with the licensees on specific safety issues within the scope of the Basic Law and the Atomic Energy Act. They are supported in this by the authorised experts consulted according to the Atomic Energy Act, usually from the TÜV and other TSOs. The staff of the TSOs are often more frequently on-site for inspections and liaison than the regulatory authorities. However, this does not diminish the relationship with the licensee nor the competence of the regulatory body

The relationship between the nuclear licensing and supervisory authorities of the Länder and the licensees is professional and constructive. The authorities strive for objective communication during supervisory visits and technical discussions. The authorities' objectives are to continuously improve the safety of the nuclear installation concerned and to learn from identified weaknesses and faults in the nuclear installation concerned and other nuclear installations. The working relationship between the authorities of both the Federal level and the Länder are characterised by a climate of trust, and transparency, while maintaining independence. This positive relationship ensures that necessary regulatory decisions are taken in an appropriate manner.

The Länder and the BfE regularly carry out inspections and reviews (together with or by the authorised experts consulted in accordance with the Atomic Energy Act), covering all safety-relevant issues of the nuclear installations. These authorities use on-site inspections to gain information about the situation and the processes in a nuclear installation independently from the licensee. There is regular reporting between

the authorities and licensees, such as monthly reports from the nuclear power plant operator on operational events. According to the Nuclear Safety Officers and Reporting Ordinance, licensees are obliged to report to the supervisory authorities any accidents, incidents or other events significant to technical safety.

3.6. STABILITY AND CONSISTENCY OF REGULATORY CONTROL

The German authorities rely on a comprehensive network of regulations and further measures that ensures that the regulatory control is exercised in a stable and consistent manner.

Sub-statutory regulations are not generally legally binding, but they still guide the decisions of the nuclear licensing and supervisory authorities and their consulted experts with respect to safety-related issues. In particular, sub-statutory regulations are made binding by respective requirements set out in the licenses. The Federal and Länder authorities also have other instruments that prevent major differences in the assessment of and decisions on safety-related issues if different authorities or different staff members within the same authority are confronted with similar situations.

There are regular, institutionalized consultations between the federal and Länder authorities dealing with nuclear issues, which ensure that involved authorities treat issues as consistently as possible. Regular exchanges in the various joint federal and Länder bodies such as the Länder Committee for Nuclear Energy (LAA) and its committees and working groups ensure a uniform understanding of the provisions of the Atomic Energy Act and the relevant subordinate regulations by the Länder nuclear licensing and supervisory authorities. The LAA with its main committee and subcommittees seeks to provide harmonisation between the Länder. The LAA meets at least once per year, and sub-committees at least twice per year. The LAA provides the main forum for resolving issues between the BMU and the Länder and amongst the Länder themselves

These bodies also discuss and approve guidelines on the uniform application of the provisions applying to a particular area, such as the Safety Requirements for Nuclear Power Plants, the Decommissioning Guide or the Handbook on Cooperation between the Federation and the Länder in Nuclear Law. In addition, BMU has the right to issue binding instructions to the Länder in individual cases, which, if necessary, can be used to enforce uniform execution of regulations.

Within the authorities, all important processes are also specified in internal documents and, in some cases, in the respective management system of the authority. The regulatory authorities consult with external experts in the case of complex safety-related and security-related issues. Interfaces to other authorities have been established as well as procedures for mutual participation and information.

The KTA as well as the advisory bodies RSK, SSK, and ESK provide further support for stable and consistent application of regulatory control for both Federal and Federal and Länder. Although the KTA rules are currently focused on NPP operation, they will still remain important after completion of the phase out in 2022 and there are intentions to keep them up to date (see module 9). The extension of their scope to interim storage sites and final repositories as well as storage and transport casks is under review.

3.7. SAFETY RELATED RECORDS

The Federal and Länder authorities have appropriate mechanisms in place to manage safety-related records. The basis for the mechanisms are several ordinances that specifies the maintenance of appropriate data records and documentation.

For records relating to NPPs, this is done in accordance with the Nuclear Licensing Procedure Ordinance. This ordinance specifies the creation and maintenance of records and documentation regarding the safety of nuclear power plants. Other publications and KTA standards, in particular KTA Standards 1404 and 1401, provide the principal documentation requirements for NPPs. These principles are also able to be used

for other nuclear installations. Operators of NPPs also have record management requirements placed in operating licenses.

In the BMU, there is a file plan to ensure easy access to records and to ensure proper storage of the files. The BMU plans to introduce an electronic file storage system in 2020.

Accidents, incidents or other events of significance for nuclear safety (reportable events) in the nuclear facilities must be reported to the supervisory authority by the license holder in accordance with the Nuclear Safety Officer and Reporting Ordinance. This also includes releases or discharges of radioactive substances into the environment that exceed the limit values. The BfE collects information about all reportable events in Germany and makes it publicly available.

In addition, a large number of notification and reporting obligations are laid down in the licenses, in particular in the licensing provisions. The licensing and supervisory authority thus receives information on the operation of the facilities both in regular intervals and with respect to individual events. These documents are evaluated by the supervisory and licensing authority and archived in accordance with the registration and archiving regulations.

The details of the communication between the competent federal authority and the Länder authorities regarding the retrieval of the corresponding data records is regulated in the Handbook on Cooperation between the Federation and the Länder in Nuclear Law.

For waste repositories, all documents prepared by the nuclear supervisory authority in its administrative activities are stored physically as well as digitally in a program designed for this purpose. The operator of the repositories is required to archive all relevant documents accordingly. The Konrad plan approval decision, for example, includes a framework description of how a documentation system for technical and license-relevant documents should be structured. The description states the principles for documenting the planning, exploration, construction/transformation and operation of facilities.

Under the Site Selection Act, there is a section entitled “Documentation, Delegated Legislation”, which assigns the task of permanently storing data and documents that are or could become important for interim storage and for disposal to the BfE. It is intended to specify this new documentation obligation by means of a legal ordinance.

The German national dose register (Strahlenschutzregister, SSR) for occupationally exposed persons has been set up in accordance with §170 of the Radiation Protection Act and is managed by BfS. An exposed worker is notified by his employer to the register via the SSR web portal or web services. To each worker, a personal unique registration number (SSR number) is assigned, which is derived from his social security number by means of a non-reversible encryption. Exposure data are fed into the register by the monitoring services with the frequency of the monitoring period, and for aircrew by the Federal Aviation Authority. Data contained in the register can be made available, as far as necessary for the performance of the recipient’s duty, to competent authorities, monitoring offices, radiation protection executives and statutory accident insurance institutions. The processing of personal data is subject to further conditions laid down in §170 of the RP Act. In that case, written consent of the persons concerned is required. For itinerant workers, radiation passbooks are to be used. They are filled out by the radiation protection supervisor with the personal data and the SSR number of the holder and given to the competent authority for registration. A new version is in preparation which will be based on the HERCA template of the European radiation passbook and be bilingual German-English.

3.8. COMMUNICATION AND CONSULTATION WITH INTERESTED PARTIES

Nuclear licensing and supervisory authorities of the Federation and the Länder communicate with interested parties in a variety of ways. These include public relations work (press statements, conferences, on-site

meetings open to the media), publications in the Federal Gazette or online, and responding to enquiries from the public.

Legal obligations for informing the general public arise from the Atomic Energy Act. Accordingly, the competent authorities inform the general public in the field of nuclear safety at least about the proper operation of nuclear facilities as well as about any reportable events and during accidents. Further legal obligations for informing the general public arise from the federal and Länder environmental information laws. If requested, all bodies of public administration are obliged to publish environmental information. Furthermore, the provisions of the Radiation Protection Act specify the information to be given to the population about protection measures and recommendations for behaviour during possible nuclear accidents and other radiological emergencies.

The competent federal bodies publish the federal emergency response plans according to standards in the environmental information laws. Furthermore, the competent federal and Länder bodies inform the population in a suitable way in accordance with standards applicable to the general provisions about the principle terminology for radioactivity and the effects of radioactivity on people and the environment, about the emergencies considered in the emergency response plans and their consequences for the population and the environment and about planned measures for warning and for the protection of the population during possible emergencies. In addition, they give the population recommendations for their behaviour during possible emergencies. According to the Radiation Protection Act, this information and the recommendations for behaviour have to be updated at regular intervals and, on the occasion of any changes, have to be published unprompted in updated form. They must be available to the public at all times.

There is no coordinated communication plan at either the Federal level or the Länder level, nor is there a formal committee of the two levels to coordinate communication. However, the LAA acts as an ad hoc body for discussing issues of communication. Given robust communication channels between the Federal authorities and the Länder, and between the Länder, effective coordination is able to occur on any given issue.

The legislator has established especially high standards of information regarding the site selection for a disposal facility for high-level waste. For example, the BfE, being the authority responsible for supervising the implementation of the site selection procedure according to the regulations of the Site Selection Act, informs the public comprehensively and systematically about the site selection procedure and hosts an online information platform where significant documents relating to the site selection procedure are published.

In order to provide citizens with easier access to this information, a joint information portal of the Federal government and the Länder titled “Nuclear Safety” (www.nuklearesicherheit.de) was created, which was put online at the beginning of 2018. This information portal, which is being developed jointly by BMU, BfS, BfE and the competent nuclear licensing and supervisory authorities of the Länder, is intended to make it possible for the public to access relevant information via a central website on the Internet.

While transparency and communication to the public are important goals, the protection of sensitive information must also be guaranteed. The Environmental Information Act defines reasons for denying access to information. In particular, if the disclosure of information had negative impacts on public safety or international relations, the information has to be protected. Specific technical information that could be misused for sabotage purposes has to be prevented from publication. This remains true even after the dismantling of German NPPs as the documents allow conclusions about NPPs abroad that are still in operation.

When decommissioning, the regulatory body issues a first license that normally covers the entire scope of the decommissioning project. A public consultation process is conducted as part of the EIA process before

issuing the first decommissioning license, particularly for facilities which are regulated under the Atomic Energy Act.

Any second or subsequent license for later decommissioning actions is issued by the Länder with new public consultation, as appropriate.

After completion of all decommissioning works, the operator shall prepare a final decommissioning report. The final decommissioning report summarises the dismantling of the facility, the radioactive waste and radioactive materials generated, and the final state of the site at the time of release from regulatory control. The release of the site from regulatory control relies on clearance according to § 33 StrlSchV in a separate administrative act. No additional public consultation is implemented during this administrative process.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>After completion of decommissioning, the release of facility and site from regulatory controls is formalized by an administrative act issued by the Länder without any additional public consultation.</i>	
(1)	BASIS: GSR Part 6 Requirement 15 states that “On the completion of decommissioning actions, the licensee shall demonstrate that the end state criteria as specified in the final decommissioning plan and any additional regulatory requirements have been met. The regulatory body shall verify compliance with the end state criteria and shall decide on termination of the authorization for decommissioning.”
(2)	BASIS: GSR Part 6 Requirement 15, para. 9.6 states that “Inputs from the public shall be addressed before authorization for decommissioning is terminated.”
(3)	BASIS: SSG 47, para 7.44. states that “In accordance with paras 7.16 and 9.6 of GSR Part 6 [1], interested parties are required to be involved in the licensing process for decommissioning, as well as in the process for termination of the authorization for decommissioning, and are required to be given an opportunity to provide comments before decisions are taken by the regulatory body and prior to the granting or termination of an authorization for decommissioning.”
R1	Recommendation: BMU should include requirements for addressing public inputs during the process of termination of the decommissioning license.

3.9. SUMMARY

The IRRS team reviewed the responsibilities and functions of the regulatory body, focusing on both the Federal level and the Länder. Overall, the IRRS team found that the regulatory authorities of Germany, at both levels, are mature and competent. There are strong practices and processes in place to ensure consistent and comprehensive regulatory oversight and effectively engage with authorized and other interested parties. There is an effective body in the LAA to coordinate between the two levels of government in Germany and to harmonize the practice of the different Länder. The regulatory authorities have sufficient mechanisms in place to attract and maintain core competencies of staff. The IRRS team found some areas for improvement related to ensuring there is adequate engineering experience in the regulatory authorities at the Federal level, and to ensure better communication with the public concerning decommissioning licenses.

4. MANAGEMENT SYSTEM OF THE REGULATORY BODY

4.1. RESPONSIBILITY AND LEADERSHIP FOR SAFETY

The Federal Republic of Germany is a federal state. Unless otherwise specified, the execution of federal laws generally lies within the responsibility of the Länder. The “regulatory body” is therefore composed of the authorities of the Federation and the Länder.

Since that there are extensive parallels between the management systems of the nuclear authorities of the Federal Government and the nuclear licensing and supervisory authorities of the Länder, in the following in this chapter the term “regulatory body” refers to all relevant authorities.

The Federal Office for the Safety of Nuclear Waste Management (BfE) and the Federal Office for Radiation Protection (BfS) – scientific-technical federal authorities are working for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The cooperation between the Federation and the Länder is organized by the Länder Committee for Nuclear Energy (Länder-ausschuss für Atomkernenergie (LAA)).

Within the frame of federal executive administration, the highest Land authorities (ministries) are responsible for the supervision of nuclear power plants and nuclear facilities. BMU performs the supervision of legality and expediency of the actions of the Länder. The organizational structure is designed according to common organizational principles in the form of Directorates-General and Directorates as well as Divisions.

Priority for safety is one of the basic principles for the work of the nuclear licensing and supervisory authorities of the Federation and the Länder. This principle is implemented in the task descriptions of the nuclear licensing and supervisory authorities. The nuclear licensing and supervisory authorities and their staff are bound by the legal provisions concerning the license and operation of nuclear installations.

The management at all levels set an example with regard to the leadership for safety and their commitment to safety. They are aware of their function and their responsibility for the effectiveness and efficiency of the management system. The actions of the senior management demonstrate to all employees that safety is a top priority in the actions of the authority. Furthermore, employees are deployed, instructed and supported in such a way that they can contribute to the effectiveness of the management system.

Organizational specifications require that appraisal interviews take place annually according to a structured guideline. As part of these interviews, the manager discusses with the staff their need for advanced training and professional development as well as perspectives on personal development. This also includes providing mutual feedback on the employee’s performance and the manager’s behaviour. During the appraisal interviews, the managers communicate their expectations regarding the actions of the staff and determine individual objectives for the coming year. Based on a guide for the appraisal interview posted on the intranet, additionally to reviewing the achievement of objectives and discussing personal development needs, any existing obstacles to safety-oriented supervisory practice are discussed and adequate corrective actions, as well as general suggestions for improvement concerning the organization, are discussed.

Measures such as an open-door concept, the development of safety mission statements, guidelines for appraisal interviews and management training are implemented to develop and strengthen the communication culture between the management and the staff as well as the regulatory safety culture.

The management system is subject to regular review and updates. When adapting processes, those staff who regularly apply the processes are involved. The management system modifications are re-leased in the regular management meetings.

4.2. RESPONSIBILITY FOR INTEGRATION OF SAFETY INTO THE MANAGEMENT SYSTEM

The regulatory body has established and is applying an integrated management system. Goals, strategies, plans and objectives for the organization are established in such a manner that safety is not compromised by other priorities.

The regulatory authorities strategic plan and supporting documents include most of the elements of a safety policy. The applicable fundamental safety principles and approach to their implementation, leadership and management for safety as well as commitment to continuous improvement are however not explicitly defined.

The annual goals of the regulatory body are established in an annual meeting of the management. The starting point is a review of the achievement of goals in the past year. Furthermore, findings from regulatory activities are taken into account which may require the setting of an annual goal in this regard.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>The regulatory authorities strategic plan and supporting documents include most of the elements of a safety policy. The applicable fundamental safety principles and approach to their implementation, leadership and management for safety as well as commitment to continuous improvement are however not explicitly defined.</i>	
(1)	BASIS: GSR Part 1 Requirement 1, para. 2.3 states that “In the national policy and strategy, account shall be taken of the following: “... (a) <i>The fundamental safety objective and the fundamental safety principles established in the Fundamental Safety Principles [1];</i> (g) <i>The promotion of leadership and management for safety, including safety culture”.</i>
(2)	BASIS: GSR Part 2 Requirement 4, states that “Senior management shall establish goals, strategies, plans and objectives for the organization that are consistent with the organization’s safety policy.”
S7	Suggestion: BMU should consider improving documentation of its safety policy by explicitly referring to applicable fundamental safety principles and approach to their implementation, leadership and management for safety, as well as commitment to continuous improvement. BfE, BfS and the Länder should consider whether similar improvements to their safety policies are needed.

4.3. THE MANAGEMENT SYSTEM

The management system of the regulatory body integrates its elements and includes health management, environmental management, regulations and provisions on confidentiality, data security, quality assurance and quality management.

The IRRS team was informed, that due to the federal structure of the Federal Republic of Germany, conflicts between the Federal Government and the Länder cannot be ruled out and for these cases written procedures exist.

The formalized decision-making processes ensure that all aspects concerned and the organizational units representing them are involved and that each decision is taken at a hierarchical level that assesses and weighs up the conflicting aspects. The management is responsible for ensuring that safety is taken into account in each decision according to its importance.

During the development of the processes, the interfaces between the individual processes and to external organizations were taken into special consideration and thus defined in the process descriptions. This relates in particular to the interfaces to TSO, advisory committees, other authorities and the license holders of nuclear installations. The commissioning of TSO is subject to the regulations of the tender procedure, in many cases on the basis of framework agreements. This specifies the TSO's assignment and further specifies the interfaces for the corresponding assignment. The cooperation of the federal and state authorities and the interfaces are described in the Handbook on Cooperation between the Federation and the Länder in Nuclear Law.

The optimization at the interfaces is the subject of continuous improvement. Feedback from those involved in the processes and stakeholders interacting with the processes is taken into account. The organizational units listed in the process descriptions in the Quality Management Manual (QM) are primarily responsible for the continuous review of process descriptions for actuality and effectiveness, taking into account the interfaces with other processes. The analysis of the extent to which processes are related and must be effectively put in relation to each other is a result of the communicative debate between the participants. If many organizational units are affected by the revision of a process description, the person responsible for the management system takes over the coordination of the review.

All proposed changes or suggestions for new process descriptions are forwarded to the person responsible for the management system, who then implements the changes in the QM and also ensures consistency with other process descriptions.

The IRRS team was informed, that a procedure has been established in the management system to identify any changes, including organizational changes that could have significant implications for safety.

The work of the managers and their relations to the employees particularly aim at establishing a value structure (communication, criticism, self-criticism, quality, efficiency, transparency, collegiality, teamwork). In this context, the managers also focus on the interfaces between the organizational units to ensure that decision-making processes are in accordance with the commitment to highest safety considering the value structure right from the start.

The documents of the management systems of individual authorities are usually available in electronic form (intranet). The creation, amendment, review, approval and (electronic) provision of documents is organized on an authority specific basis. The documentation of all processes is ensured by the process owners.

The documentation of the management system is subject to control insofar as, depending on the quality of documents/records, an evaluation and approval of these documents is generally required. This applies to both, the first approval and the approval after amendment. The documents/records to be controlled are also documented in such a way that changes and the current revision status are visible, and the currently valid version is available to the persons involved.

The BfE is in the establishment phase. In some cases, new tasks have to be implemented, whereas, in other tasks previously assigned to the BfS have been reassigned to the BfE. At the same time, previous

responsibilities of BfS have been transferred to the newly founded Federal Company for Radioactive Waste Disposal.

The challenge associated with the comprehensive organizational restructuring is to transfer previously established structures, resources, processes and systematics of the management system to the new organizations without interruption of effectiveness.

The IRRS team noted, that the management system for the newly founded BfE is currently under preparation, but has not yet been fully implemented.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>BfE has not yet completed the establishment and implementation of its integrated management system.</i>	
(1)	BASIS: GSR Part 1 Requirement 19 states that <i>“The regulatory body shall establish, implement, and assess and improve a management system that is aligned with its safety goals and contributes to their achievement.”</i>
(2)	BASIS: GSR Part 2 Requirement 3. states that <i>“Senior management shall be responsible for establishing, applying, sustaining and continuously improving a management system to ensure safety.”</i>
R2	Recommendation: BfE should complete the establishment and implementation of its integrated management system.

4.4. MANAGEMENT OF RESOURCES

Managers at all levels are involved in the determination of resources requirements. Senior management of DG S submits the requirements identified to the competent organizational unit in the DG Z (Directorate Central) which is in charge of taking further steps with regard to the budget legislation.

Employees are obligated to enhance their qualification by training on the job and attending training courses (principle of lifelong learning). Compensation is made for competences/resources not available in DG S by commissioning external experts or technical support organizations.

The needs assessment follows a bottom-up process as part of the establishment of the budget. The organizational units determine their financial and human resources requirements and advocate them at all levels of the hierarchy. The budget is submitted to and adopted by the Federal Parliament and the Länder parliaments. The respective minister represents the subchapters of the budget related to their area.

The managers of the organizational units concerned with the task of the licensing and supervisory authorities specify the human, material and financial resources required in this area. The further development and deepening the competencies is subject of the training plans and personnel development. The experts are often consulted on the basis of long-term framework agreements. This ensures that the required capacities and competencies are predictable and can be made available by the expert organizations.

In the BMU, the senior management defines the scope of the required resources and submits the requirements identified to the organizational unit responsible for human resources at the Directorate-

General Z. The requirements of human resource by the political management of the BMU with regard to the budget legislation take into account the assessments made by the senior management regarding the necessary human resources.

The senior management defines the competence requirements, especially for new hires. In addition to the introductory training programs, existing personnel are encouraged to develop their skills by regularly taking part in training programs on specialists' topics, for example at GRS.

In addition to the management system of the Directorate-General S a web-based Portal for Nuclear Safety (PNS) was established as an instrument of knowledge management for further support and for the preservation of knowledge at the BMU, the Länder, technical safety organizations and other institutions. This "InfoServer" provides a standardized and clear web-based platform for information and knowledge management for nuclear safety and security, including radiation protection and disposal across all institutions.

The portal is operated and administrated by GRS on behalf of the BMU and used for cooperation with, among others, BfE, BfS, nuclear authorities of the Länder and their experts. There are knowledge sites on selected topics and also collaboration sites on which, e.g. meeting documents of Federation-Länder-committees are deposited, as well as sites where documents and results of research and development projects funded by the BMU and other federal ministries are documented (project sites). For the knowledge sites, compilations of documents and important expert organizations for nuclear authorities and expert organizations are classified, structured and provided electronically. The website 'management', for example, contains the information and tools necessary and useful for practical work with the InfoServer. Support processes and information, deadlines or documents of overall importance are provided here. The IRRS review team considered this as an area of good performance.

4.5. MANAGEMENT OF PROCESSES AND ACTIVITIES

The regulations for the state administration and the ministries include processes and actions such as suggestion system, company parties, company outings aimed at job satisfaction and human and organizational factors. The communication with the public, the handling of the state budget and the social responsibility of employees are also clearly regulated.

The management system of the Directorate-General S (including the processes of the Handbook on Cooperation between the Federation and the Länder in Nuclear Law) is based on these regulations. The processes are designed in such a way that these general requirements, insofar as they are relevant to them, are met. However, the focus of the processes is on the regulation and monitoring of nuclear safety. This ensures that nuclear safety is not compromised by other objectives.

The management system of the regulatory body is divided into core processes, management processes, and supporting processes.

An essential tool used to manage the processes in the regulatory body is the annual discussions of the quality manager with the heads of directorate. The results of the talks are summarized, and the corrective actions decided at a management meeting. The procedures are approved by the Director General.

During the development of the processes, the interfaces between the individual processes and external organizations were taken into special consideration and thus defined in the process descriptions. This relates in particular to the interfaces to TSOs, Advisory Committees, other authorities and the license holders of nuclear installations.

The optimization at the interfaces is the subject of continuous improvement. Feedback from those involved in the processes and stakeholders interacting with the processes is taken into account. The organizational

units listed in the process descriptions in the QM manual are primarily responsible for the continuous review of process descriptions for actuality and effectiveness, taking into account the interfaces with other processes. The analysis of the extent to which processes are related and must be effectively put in relation to each other is a result of the communicative debate between the participants. If many organizational units are affected by the revision of a process description, the person responsible for the management system of the Directorate-General S takes over the coordination of the review.

All proposed changes or suggestions for new process descriptions are forwarded to the person responsible for the management system, who then implements the changes in the QM manual and also ensures consistency with other process descriptions. The procedure for determining the effectiveness of the interaction of the processes covered in the supervision manual is the responsibility of the technically competent Division.

In view of the discussions held in module 5 (authorization) and module 6 (review and assessment) for research reactors, the IRRS team noted that there is no procedure for regulatory supervision processes in the management system of the Länder. The Bavarian State Ministry of the Environment and Consumer Protection (StMUV) informed that they are developing “Handbook for the Länder’s supervision on high flux neutron sources of Munich in Garching (FRM-II)” which describes, amongst others, regulatory supervision processes e.g., licensing, review and assessment, inspections, etc. It was, however, informed that the document is in the draft form and may take a few years to finalize.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>The internal management system process for licensing of research reactors is not available in a documented form. The Land (StMUV) is developing a “Handbook for the Land supervision on high flux neutron sources of Munich Garching (FRM-II)” which includes, amongst others, all regulatory supervision processes e.g., licensing, review and assessment, inspections, etc.</i>	
(1)	BASIS: GSR Part 2 Requirement 8, states that <i>“The management system shall be documented. The documentation of the management system shall be controlled, usable, readable, clearly identified and readily available at the point of use.”</i>
(2)	BASIS: GSR Part 2 Requirement 8, para 4.16, states that <i>“The documentation of the management system shall include as a minimum: policy statements of the organization on values and behavioural expectations; the fundamental safety objective; a description of the organization and its structure; a description of the responsibilities and accountabilities; the levels of authority, including all interactions of those managing, performing and assessing work and including all processes; a description of how the management system complies with regulatory requirements that apply to the organization; and a description of the interactions with external organizations and with interested parties.”</i>
(3)	BASIS: GSR Part 2 Requirement 10, para. 4.28 states that <i>“Each process shall be developed and shall be managed to ensure that requirements are met without compromising safety. Processes shall be documented and the necessary supporting documentation shall be maintained.”</i>
(4)	BASIS: GSG-13, para. 161 states that <i>“In order to provide assurance that all topics</i>

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	<i>significant to safety will be covered consistently with submissions for similar facilities or activities, review and assessment should be carried out by means of a systematic and formalized process implemented through specific procedures. “</i>
S8	Suggestion: The Land (StMUV) should consider finalizing the handbook as a priority. The other Länder should consider developing similar documents as appropriate.

The main external bodies which provide services to the licensing and supervisory authorities in Germany are TSOs and Advisory Bodies. The requirements for the TSOs are specified in the contracts, the requirements for the Advisory Committees in the consulting requests. The general requirements and principles are often specified in framework agreements with the TSOs or in the rules of internal procedure of the Advisory Bodies. For time to time, strategic discussions are held with the external organizations in order to adapt to longer-term developments, to determine strategic specifications and to explain expectations. There is a clear understanding among all parties that the support organizations provide technical support to the authority in the interest of safety, but that the evaluation of the expert opinions or statements is the responsibility of the authority. The authority determines which safety provisions are to be taken, e.g. with regard to the license holder of nuclear installations and is also responsible for them.

4.6. CULTURE FOR SAFETY

Based on the communicated expectation individuals and the organization establish and maintain a positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations.

The management system of the regulatory body provides methods for safety culture, e.g. guiding principle in the mission statements, reflections by means of the open-door policy or the appraisal interviews with the employees.

Process towards harmonization of the understanding of regulatory safety culture across German authorities started in February 2018.

BMU pays particular attention to developing and strengthening a common understanding of safety, which is reflected in the safety culture. The safety culture is essentially based on managers giving clear signals to the employees that priorities are supported in the individual decisions by the management level and that any existing conflicts are resolved. This is implemented by regular consultations/meetings at various levels, during which a proactive exchange of ideas is also desired. In addition, the head of the Directorate-General leads information events, which also serve as a basis for a safety- oriented attitude, responsibility and behaviour of all employees.

Principles for a common organizational culture of the BfE were developed and aspects such as self-questioning, readiness to act transparently, necessity of an open error management culture and other aspects promoting the safety culture were defined as guiding principles. The principles of action are to be replaced at a later point of time, when the establishment of the Office has further progressed, by a mission statement developed in cooperation with all employees.

At the UM BW a security culture self-assessment was conducted last October using a questionnaire based on IAEA Nuclear Security Series No. 28-T. The regulatory body is planning to develop a questionnaire for

self-assessment of safety culture. As a first step a draft document, “position paper” on “Safety culture in nuclear licensing and supervisory authority” has been elaborated. This paper states and explains the principles of the joint-developed understanding of safety culture. It covers the fields of nuclear safety and radiation protection in the case of nuclear facilities and of transportation of nuclear fuels.

The IRRS team was informed that a process for the development and strengthening of a common understanding of the safety culture within all supervisory and licensing authorities has been started. However, the IRRS team noted, that the regulatory body in Germany has not yet conducted formal assessments of safety-related management and the safety culture.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>The regulatory body has started a process for the development and strengthening of a common understanding of safety culture within the supervisory and licensing authorities, however, assessment of leadership for safety and of safety culture has not yet been conducted covering all regulatory authorities.</i>	
(1)	BASIS: GSR Part 2 Requirement 14, states that “Senior management shall regularly commission assessments of leadership for safety and of safety culture in its own organization.”
R3	Recommendation: The regulatory body should regularly commission assessments of leadership for safety and of safety culture.

4.7. MEASUREMENT, ASSESSMENT AND IMPROVEMENT

Senior management review is conducted at planned intervals to confirm the suitability and effectiveness of the management system, and its ability to enable the objectives of the regulatory body to be accomplished, with account taken of new requirements and changes in the regulatory body.

Managers prepare various inputs for the management review, e.g. suggestion for improvement from their divisions, meetings with stakeholders and employees, staffing and technical resources, comparison with other authorities and national/international requirements.

In the Directorate-General S, the existing communication culture ensures that the effectiveness of all-important activities is checked and evaluated. The responsibilities of the heads of divisions ensure that the senior management is informed accordingly in cases where the organization is no longer effective. The necessary further development and adaptation of the work organization is carried out by the senior management.

At the BfE based on European Standards and the BfE Management Handbook, audits are planned to be conducted at regular intervals.

The electronic QM manual with descriptions of the processes relevant for the Directorate- General S was developed in cooperation with external experts. However, the IRRS team was informed, that the overall management system of the regulatory body is not subject to evaluation by independent third parties.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *Independent assessment of the management system of the regulatory body is not conducted to evaluate its effectiveness and to identify opportunities for its improvement.*

(1)	BASIS: GSR Part 1 Requirement 3, states that “Independent assessments and self-assessments of the management system shall be regularly conducted to evaluate its effectiveness and to identify opportunities for its improvement. Lessons and any resulting significant changes shall be analysed for their implications for safety. ”
R4	Recommendation: The regulatory body should conduct independent assessments of the management system regularly to evaluate its effectiveness and to identify opportunities for its improvement.

4.8. SUMMARY

The BMU and UM BW have established and are applying an integrated management system. BfE is in the establishment phase thus its management system is currently under preparation and not completed yet.

The IRRS team noted several observations concerning the comprehensiveness of the existing management systems with reference to IAEA Safety Standards GSR Part 1 and GSR Part 2. Specifically, there is a need to take into account all requirements of IAEA Safety Standards related to the management system. These should include developing and implementing the policies and processes, such as a fully developed safety policy, regular assessment of safety culture and independent assessment of the management system.

The IRRS team also noted an area of good performance such as the regulatory body has developed an effective database, “Portal for Nuclear Safety”, the benefit of which is to preserve and keep up to date the knowledge gained during the use of atomic energy in Germany.

5. AUTHORIZATION

5.1. GENERIC ISSUES

The licensing and supervision of nuclear installations, other than nuclear waste management facilities, is generally performed by the competent authorities of the Länder on behalf of BMU, whereas the promotion of the energy sector including reactor safety research falls within the competence of the Federal Ministry for Economic Affairs and Energy (BMWi). In the Länder, the highest Land authorities have been designated as the competent authority. There is also an effective separation at the Länder level between the tasks of the nuclear licensing and supervisory authority and the competent authority for economic development.

The licensing and supervision of certain waste storage and disposal facilities are performed by the Federal Office for the Safety of Nuclear Waste Management (BfE), established as an authority within the portfolio of the BMU.

5.2. AUTHORIZATION OF NUCLEAR POWER PLANTS

Currently seven nuclear power plants (NPPs) are in operation phase, two NPPs in post operation phase, 24 NPPs are in decommissioning phase and three NPPs have completely decommissioned. The Government of Germany has decided to phase out the use of nuclear energy by 2022 for commercial generation of electricity and not to install any new nuclear power plant. Accordingly, the licensing of NPPs is mainly limited to modifications of operating NPPs and decommissioning.

In order to obtain a licence, a written licence application along with the necessary documents, as required under the Nuclear Licensing Procedure Ordinance, is submitted to the relevant Land. The Land examines the submitted documents to verify compliance with the legal and regulatory requirements. In its licensing procedure, the Land also involves relevant authorities whose area of responsibility may be affected. In cases where there is a potential for trans-boundary environmental impacts, authorities of other states are also involved. As part of the licensing process, it is necessary to examine to what extent the public has to be involved and whether an environmental impact assessment is required.

As a rule, expert organizations (TSOs) are tasked with examining the application documents in support of the Land. The experts prepare opinions on the basis of which the Land decides whether the requirements of nuclear safety and radiation protection are fulfilled. The Land also informs BMU in writing about the existence of a licence application if:

- it considers the licensing procedure to be significant,
- it concerns a licensing procedure for which the BMU has requested information (capacity increase, introduction of digital instrumentation and control technology in safety systems) or
- BMU considers federal participation to be necessary in particular case in question.

If BMU concludes that it should conduct a federal supervisory review, BMU can request a federal supervisory review before issuing the licence. BMU specifies the relevant points for review and the documents to be transmitted. The Land sends the corresponding documents to BMU. BMU initiates a status discussion with the Land in order to exchange information and opinions on the status and the further procedure. In addition, if new, amended, additional, previously unknown or unconsidered licensing documents are to be introduced in the procedure, the Land submits these to BMU. BMU may consult GRS to receive technical support as well as seek advice from its advisory bodies for conducting federal supervisory review. The licensing authority of the Land and its authorized expert may also participate in these deliberations. Upon completion of the review, BMU sends its federal supervisory statement to the Land. The Land confirms to the BMU the consideration of any federal supervisory requirements before issuing the licensing notice.

On the basis of the application documents, the expert opinions of the authorised experts and, if available, the statement of the BMU and the authorities involved as well as the findings in connection with the objections raised by the public at the time of the hearing, the Land takes its decision on the application and communicates to the applicant.

Once a decision is made by the Land, the authorised party can appeal in a court of law against the decision. No appealing process exists within the Land administration that allows the authorized party to appeal against the regulatory decision to the Land. The counterpart pointed out that such decisions are taken within the Land at the highest level i.e., ministry. Since an appeal can only be made to the authority at least one level higher and as there is no one above the ministry within the Land organization, therefore, provision for appeal within the Land is not possible.

5.3. AUTHORIZATION OF RESEARCH REACTORS

At present, seven research reactors (RRs) are in operation, three RRs are in post operation phase, seven RRs are in different phases of decommissioning whereas twenty-nine RRs have completed decommissioning. During the mission, discussion regarding licensing of research reactors was held with the representatives of the Bavarian State Ministry of the Environment and Consumer Protection (StMUV), the responsible Land for regulatory supervision of Hochflussneutronenquelle München/Garching (FRM-II), a 20MWth research reactor.

The IRRS team was informed that the licensing process for research reactor is same as that for the nuclear power plants. The standards applicable to NPPs are applied for research reactors also by applying graded approach consistent with the level of associated risks and hazards. However, application of the graded approach is not documented and is applied by individuals based on their expertise. The same practice is followed, amongst others, to the safety code and guide on contents and structure of safety analysis report (SAR). The code on contents and structure of SAR for NPPs is available which is also used for SAR of RRs by applying graded approach. The IRRS team noted that using standards applicable to NPPs to RRs without any written guidance document or procedure may bring inconsistency if applied by different individuals. A suggestion in this regard is provided in Module 9.

Regarding the licensing process and the internal management system documents for the licensing process of the Land, the counterparts informed that they are developing “Handbook for the Länder’s supervision on high flux neutron source of Munich Garching (FRM-II)” which describes, amongst others, all regulatory supervision processes e.g., licensing, review and assessment, inspections, etc. It was, however, informed that the document is in the draft form and may take few years to finalize. A suggestion on this issue is provided in Module 4.

5.4. AUTHORIZATION OF FUEL CYCLE FACILITIES

The authorization framework for FCFs (both front-end and back-end fuel cycle facilities) is the same as for NPPs. The licensing procedures for the FCFs are carried out in accordance with the Nuclear Licensing Procedure Ordinance (AtVfV), pursuant to §7 AtG.

The responsibility for subsequent licensing and for supervision rests with the relevant Land. The Land informs the relevant Federal Ministries, including the BMU, as far as necessary, and the BMU comments on the draft decision of the competent nuclear authority of the Land. The Land authority must take the opinion of the BMU into account in its decision-making.

Subsequent amendments of the license are evaluated by the Land authority.

Three FCFs are operating in Germany:

- The Lingen Fuel Fabrication Plant (ANF).
- The Gorleben Spent Fuel Pilot conditioning facility (PKA)
- The Gronau Uranium Enrichment Plant (UAG)

The Competent Regulatory Body for the ANF and the PKA is the Ministry for the Environment, Energy, Building and Climate Protection of the State of Lower Saxony.

The Competent Regulatory Body for the (UAG) is the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia.

Five other fuel fabrication facilities operated in the past and have been decommissioned and released from the regulatory control. In Karlsruhe there is a reprocessing plant (WAK) and a vitrification facility (VEK) both in decommissioning phase.

The Gorleben SF Pilot Conditioning facility is authorized only to perform maintenance on defective spent fuel (SF) casks. The IRRS team was informed that, according to the German SF management strategy SF conditioning will not be necessary in this facility in the future.

The decommissioning plans for operating FCFs are reviewed every 5 years.

The PKA never went into hot operation and there is a plan to close the facility.

5.5. AUTHORIZATION OF RADIOACTIVE WASTE MANAGEMENT FACILITIES

Authorization of spent fuel storage facilities

The spent fuel storage facilities have been considered in the Self-Assessment provided by Germany for this IRRS as waste management facilities.

Spent fuel is stored in Germany in four (4) off-site dry cask storage facilities (Ahaus, Gorleben, Jülich and Rubenow) and twelve (12) on-site dry storage facilities.

The storage of spent fuel and radioactive waste with contents of nuclear fuel, requires a licence according to § 6 AtG. The licensing authority is the Federal Office for the Safety of Nuclear Waste Management (BfE), whilst post-licensing supervision is performed by the competent authority of the respective Land. Uniform application of the legal requirements and harmonised practice is ensured by the BMU's supervision.

Although the licenses were originally issued to the utilities, from 1 January 2019 responsibility for the operation of the storage facilities for heat-generating waste was transferred to BGZ in accordance with the Waste Management Transfer Act (2017).

The storage of nuclear fuel is permitted as an activity under § 6 AtG. This type of activity-related to a licence differs from a licence for a facility under § 7 AtG. Handling of SF, i.e. loading of SF into a cask, is regulated under the license of the NPP according to § 7 AtG.

Licenses for SF storage facilities have been granted for a maximum of forty (40) years. Since commissioning of a disposal facility for heat generating waste is not expected before 2050, it is expected that licensees will need to make applications for extended storage. At the moment, no regulatory specifications have been developed for extended storage. BMU has, however, initiated research projects to collect basic information and data on national and international experience, in order to assess the safety issues related to the extended storage of spent fuel.

The licensing process for spent fuel storage is required to include an EIA, unless the license applied for only covers a period less than ten (10) years (i.e. only short-term storage in view of the transfer of SF to a Centralized storage facility).

The IRRS team noted that the regulatory system has been applied in a different way for two particular facilities where the original license has been revoked for different reasons, (AVR Julich and the Brunsbittel Spent fuel storage facilities). Although these facilities are waiting for a new license, they are continuing to operate under an Order issued under § 19 AtG by the supervising authorities.

Authorisation of storage and conditioning facilities for radioactive waste with negligible heat generation

The construction, operation and decommissioning of facilities for the safekeeping and disposal of radioactive waste and significant modification at facilities requiring licensing under §6, 7, 9 or 9b are licensed by means of plan approval or licensing in accordance with § 9b of the Atomic Energy Act.

For waste management facilities that do not fall under this category the handling of radioactive substances requires a licence under the Radiation Protection Act, issued by the Land authority. These facilities include collection facilities for waste from small users, storage facilities for radioactive waste with negligible heat generation including those at research centres and waste conditioning plants. Mobile conditioning plants are licensed by the Land authority in which the company owning the plant is located. Their use at facilities licensed under the Atomic Energy Act and Radiation Protection Act is licensed under the appropriate operating licences.

Authorisation of disposal facilities for radioactive waste

There are two main categories of radioactive waste in Germany, heat generating waste (spent nuclear fuel and high-level radioactive waste from reprocessing of spent nuclear fuel) and radioactive waste with negligible heat generation (e.g. low and intermediate level waste such as contaminated and activated items).

There is no disposal facility for heat generating waste in Germany. The preferred method of disposal is in a mine within a deep geological formation to ensure safety for a period of one million years. The Site Selection Act came into force in 2013 and was amended in 2017 and enables issue of statutory ordinances on introduction of safety requirements, requirements for the performance of preliminary safety analyses relating to disposal and documentation of radioactive waste disposal. These are currently being developed and will take into account the existing Safety Requirements for Disposal of Heat Generating Waste published in 2010. BfE will be the licensing authority.

There are two disposal facilities for radioactive waste with negligible heat generation. The facility at Morsleben has not been authorised to accept radioactive waste for disposal since 2001 and closure is planned for 2028. The facility was licensed in the former German Democratic Republic, currently the Land is the licensing authority. The closure of the facility will be subject to plan approval under § 9b of the Atomic Energy Act.

The disposal facility at Konrad is currently under construction and due to be commissioned in 2027. It was licensed under the “plan approval” procedure finalised in 2002. Currently the licensing authority is the Land authority but responsibility for licensing will be transferred to BfE at the start of operation.

The Asse II mine was used as a research facility for the disposal of waste between 1967 and 1978 and was licensed under the Radiation Protection Ordinance. In 2013 the Atomic Energy Act was amended to include a law to accelerate retrieval of waste from the Asse II mine and its closure, as it is not suitable for disposal of the emplaced waste. Asse II is subject to ongoing nuclear supervision by BfE under the Atomic Energy Act

The radioactive waste to be retrieved from the Asse II mine is to be taken into consideration in the location for a disposal site for heat generating radioactive waste. Retrieval does not require a planning decision. Predisposal waste management steps beyond retrieval may require licensing under the Atomic Energy Act or Radiation Protection Ordinance.

The planned retrieval of radioactive waste from the Asse II mine is an unusual situation and presents a number of significant challenges, which are clearly recognised by the government. The retrieved waste will need to be processed into a form suitable for interim storage pending the availability of the disposal site for heat generating waste. An integrated approach is being developed to take into account the interdependences between waste retrieval, processing, storage and disposal in planning the regulatory approach to retrieval and subsequent management of waste from the Asse II mine.

5.6. AUTHORIZATION OF DECOMMISSIONING ACTIVITIES

The licensing process for NPP decommissioning can be performed in one or more steps. In practice, for some NPP units a two-step process has been implemented. In these cases, a ‘first’ licence has been issued covering the overall approach to decommissioning, the full period of the decommissioning project, and including some specific (e.g. early) decommissioning tasks. Licence conditions have been specified requiring the operator to provide more detailed information on certain (e.g. later) decommissioning tasks as necessary. A ‘second’ license has been issued in such cases to cover further decommissioning tasks proposed by the operator.

The list of submittals documents for the first application is identified in the Decommissioning Guide for nuclear facilities regulated under the §7 of the AtG (2016). No timeframe is specified in the first license for the decommissioning actions to be performed. The first decommissioning license is an overarching document covering all aspects of decommissioning until completion of dismantling actions. When necessary, milestones for specific phases or tasks may be identified in the first license which may require additional safety assessments and approvals by the regulatory body. There is no situation where a decommissioning project could be implemented in a phased approach with successive licenses for each phase, which may require a specific regulatory process to check and control end-points achievement before going to the next phase. The achievement of end-points of each phase is addressed at the end of decommissioning when the operator develops the final decommissioning report.

There is a Decommissioning Guidance “Guide to the decommissioning, the safe enclosure and the dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act” and an ESK Recommendation Guidelines for the decommissioning of nuclear facilities” (2015) where all safety requirements are present.

Provisions are given in the Decommissioning Guide (2016) for the content of the documentation to be delivered to the competent authority after release of the site. No specific provisions are given for the identification of all the relevant data that needs to be preserved after the termination of the license, neither the process for their retention. It is particularly important that the further users of the sites, as for instance the radioactive waste and spent fuel storage operators, are informed about the nature of activities that were conducted at the site.

The IRRS team has acknowledged that, within Action 9.1 of the Action Plan, in the updating of the “Guide to the decommissioning, the safe enclosure and the dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act”, BMU will address the issue on the identification of all the relevant data to be preserved after termination of the license and how they are maintained after termination of license.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *The decommissioning regulations do not establish requirements for the identification of all the relevant data that needs to be preserved after the termination of the license, neither the process for their collection and retention.*

(1)	BASIS: GSR Part 6 Requirement 5, para 3.3 states that <i>“Establishing requirements for the collection and retention of records and reports relevant to decommissioning, and for preserving information about the activities that have been conducted at the site;”</i>
(2)	BASIS: GSR Part 6 Requirement 9 Para 9.7. states that <i>“A system shall be established to ensure that all records are maintained in accordance with the requirements for retention of records specified in the integrated management system and with the regulatory requirements. This system shall ensure that the new users of the site after its release from regulatory control are informed about the presence of a facility on the site in the past, and about the nature of the activities that were conducted at the site.”</i>
(3)	BASIS: SSG 47, para. 3.19 states that <i>“Certain records developed during the decommissioning project will be important for legal purposes after the facility’s licence has been terminated. Such records should be identified and preserved, and the responsibility for their retention should be assigned clearly.”</i>
S9	Suggestion: The regulatory body should consider updating decommissioning guidance to identify and maintain all relevant data which must be preserved after termination of the license.

5.7. AUTHORIZATION ISSUES FOR OCCUPATIONAL EXPOSURE

Types of practices requiring a license through the Radiation Protection Act are mostly enumerated in §12 of this Act. In general, a graded approach is applied with respect to whether a practice needs a license, a notification or a registration.

§13 of the Radiation Protection Act sets the general conditions for the granting of a licence and the documents that are required to apply for an authorization through the Radiation Protection Act are enumerated in annex 2 of this Act. These contain the relevant aspects of radiation protection and in particular occupational radiation protection.

For practices having a license under the Atomic Energy Act, such as NPPs (cfr. Ordinance for licensing according to §7 Atomic Energy Act), storage facilities (§6 Atomic Energy Act), and transport of nuclear fuel (§4 Atomic Energy Act), a separate license under the Radiation Protection Act is not required (cfr. §10a added to the Atomic Energy Act by the Radiation Protection Act). However, the radiation protection aspects are covered in the Atomic Energy license, since obtaining such a license requires a safety report covering amongst others the radiation protection aspects.

For practices requiring no license but only a notification or registration, the required supporting documents are detailed for each type of practice separately in the Radiation Protection Act. The external technical expert confirms in his report whether all radiation protection measures, including those related to

occupational protection, are taken. In the practices where an external technical expert is not required, such as maintenance for x-ray devices, it is the responsibility of the RP Executive.

Essential for activities pursuant to the Radiation Protection Act are the radiation protection principles of justification and optimization. §6 of the Radiation Protection Act explicitly states that occupational exposure shall be taken into account in the process of justification of new practices. Practices that are forbidden are listed in Annex 1 of the Radiation Protection Ordinance. Practices that are not in this list, are supposed to be justified. However, if the Competent Authority of the Land where an authorization is applied for has a doubt that the practice for which authorization is requested, is “new” and cannot be justified, the Competent Authority informs the BMU. BMU then seeks the advice of the BfS. The BfS has to give its advice within 1 year. BMU can then decide to have the practice included in the list of unjustified practices. §8 of the Radiation Protection Act requires avoidance of unnecessary exposure and dose reduction.

Anyone who plans or performs a practice or has a practice performed shall ensure compliance with the dose limits (§ 9 of the Radiation Protection Act). The RP Executive has to ensure compliance with all provisions concerning radiation protection, including compliance with the dose limits.

The radiation protection Supervisor in NPPs is involved for all work permits involving occupational exposures. The way in which such a permit is given, has to be detailed in the operating manual of the plant (KTA 1201). For other types of installations, it should be included in the radiation protection program (§45 (2) 2 of the RP Ordinance).

§25 of the RP Act and annex 2, Part E stipulate that information that outlines the distribution of tasks between the employers of outside workers and the licensees must be provided. This is usually done by contractual agreements, called “delimitation contract”. This kind of contract is submitted along with the application for a license.

For practices licensed through the Atomic Energy Act, organizational, procedural and technical arrangements regarding designated areas and monitoring of workplaces are part of the safety report that has to be remitted in the license application. For other practices, the documents to be provided are detailed in annex 2 of the Radiation Protection Act. These include also the organizational, procedural and technical arrangements regarding designated areas and monitoring of workplaces. A graded approach is applied.

For practices licensed through the Atomic Energy Act, assessment and recording of occupational exposure and health surveillance of workers is part of the safety report. For other practices, the documents to be provided are listed in annex 2 for the different types of practices.

For practices licensed through the Atomic Energy Act, information, instruction and training of workers is part of the safety report. For other practices, the documents to be provided are listed in annex 2 for the different types of practices.

Requirements on special arrangements for protection and safety of female workers and for persons under 18 are not explicitly documented in the licensing process, but all radiation protection provisions have to be complied with.

When reference levels for radon in workplaces are exceeded and the dose level cannot be lowered, notification is required. If the dose is expected to exceed 6 mSv per year, the dose has to be determined and data have to be sent to the national dose register, and health surveillance has to be organized. In any case the dose limits for occupational exposure cannot be exceeded.

For other existing exposure situations, the person responsible has to register with the CA, the dose limits have to be met. If the dose is expected to exceed 1 mSv per year, the dose has to be determined and data have to be sent to the national dose register. Health surveillance has to be organized if the dose is expected to exceed 6 mSv in a year.

5.8. SUMMARY

Länder are responsible for licensing of facilities except for certain waste storage and disposal facilities for which licensing is performed by BfE, established as an authority within the portfolio of the BMU. The licensing process has generally been found in line with IAEA Safety Standards, however, some issues have been identified in the documentation for waste management and decommissioning. Related observations have been made in Sections 9.3, 4.5, and 5.6. In addition, observations were made regarding provision of guidance on application of graded approach, finalization of handbook for research reactors, specifying requirements and process for termination of decommissioning licences and establishing responsibilities for maintaining record of the facilities after termination of the licence.

6. REVIEW AND ASSESSMENT

6.1. GENERIC ISSUES

6.1.1. MANAGEMENT OF REVIEW AND ASSESSMENT

In order to determine whether the applicant's or the authorized party's submissions demonstrate compliance with all safety requirements stipulated or approved by the regulatory body, the competent licensing and supervisory authorities of the Länder carry out extensive reviews and assessments of all relevant information both prior to issuing a license and after the granting of the corresponding license under the Atomic Energy Act and the Radiation protection Act.

The nature of the reviews and assessments by the licensing and supervisory authority of the Land depend on the safety significance of the intended measure and/or the condition of the installation. The licensing and supervisory authority of the Land ensures the comprehensive reviews and assessments with a corresponding structural and procedural organisation and provides the required qualified personnel.

Update the process of licensing activities of the Handbook

The IRRS team noticed that the Action Plan 5 of the ARM states that the Handbook describes the important processes in the enforcement of the Atomic Energy Act by the Länder, including federal government oversight in the context of federal executive administration according to the Basic Law. The licensing and supervisory authorities of the Federation and the Länder determine the need for an extension of the Handbook to include processes in licensing areas such as authorization, review and assessment and inspection other than the enforcement.

The Handbook was developed primarily for nuclear power plants. The IRRS team considers that the process in the Handbook needs to be extended to other nuclear facilities such as RRs and decommission of NPPs (see Module 1).

Routine revision of safety assessment

The safety assessment has to be periodically reviewed and updated at predefined intervals in accordance with regulatory requirements. For example, the Safety Analysis Report (SAR) is a part of the overall justification of plant safety and it should reflect the current state and the licensing basis of the plant and should be kept up to date accordingly (This is sometimes referred to as a 'living' SAR).

The Länder Authorities have monitored and reviewed the updating information on the safety assessment conducted by the licensee periodically in case of modifications of NPPs or its operation subject to licensing or any changes in the Safety Analysis Report. Updating of the safety assessment has provided a baseline for the future evaluation of monitoring data and operation performance, etc.

6.1.2. ORGANIZATION AND TECHNICAL RESOURCES FOR REVIEW AND ASSESSMENT

In accordance with the requirements in the Atomic Energy Act, authorised experts are usually consulted as part of the reviews and assessments to provide expert support. On behalf of the regulatory body, the authorised experts carry out, i.e. independent calculations, review design drawings, inspection plans and other documents, and prepare expert opinions and expert statements. The final assessment and decision, however, rests with the Regulatory Body. The authorised experts according to the Atomic Energy Act are commissioned by the competent nuclear licensing or supervisory authority.

The BMU uses the external expertise of several technical expert organisations, including GRS, Brenk Systemplanung GmbH, Physikerbüro Bremen and Öko-Institut e.V.

The supervisory authorities of the Länder examine the technical qualification of the responsible personnel both with regard to newly hired personnel based on the initial qualification as well as the proof that the technical qualification has been maintained on the basis of the personal training certificates. Trustworthiness examinations are governed by the Atomic Energy Act.

6.1.3. BASES FOR REVIEW AND ASSESSMENT

The reviews and assessments carried out by the Länder Authorities and TSOs are focused in particular on:

- adherence to the provisions, obligations and other provisions of the licensing notices,
- adherence to the provisions of the Atomic Energy Act, the Radiation Protection Act, associated ordinances and other technical safety codes and guides and
- adherence to supervisory orders.

The scope and frequency of the review and assessment arise from the nuclear and radiation protection regulations, from the stipulations of the licenses and from findings of the continuous supervision carried out by the Länder Authority.

Important items of the review and assessment by the Länder Authority are as follows:

- Examination of the condition and functioning of the installation,
- Examination of the operating behaviour of the installation,
- Examination of operating management and adherence to regulations,
- Implementation of external experience, and
- Higher-level and other activities, such as physical protection and radiation monitoring.

The findings of the reviews and assessments and the resulting regulatory decisions are documented, and the associated documents and reports are archived according to the standards of official procedures.

Internal guidance for review and assessment

The IAEA GSG 13 states that “the regulatory body should provide internal guidance on the procedures to be followed in the review and assessment process and guidance on the safety objectives to be met. Detailed guidance on specific topics for review and assessment should also be provided, as necessary. The regulatory body should employ a systematic plan to provide assurance that all the topics significant to safety will be covered and that operators of similar facilities will be treated equally”.

This guidance will also assure the quality and uniformity of staff safety reviews and provide information about regulatory matters widely available so to improve communication with stakeholders and increasing understanding of the regulator’s review process.

Neither Federation nor Länder authorities have developed internal guidance for the review and assessment process, for example, a review guidance for Safety Analysis Report and a review guidance for PSR report submitted by the operator.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *Neither Federation nor Länder authorities have developed internal guidance for their review and assessment process.*

(1)	BASIS: GSG 13, para. 3.72. states that <i>“In order to ensure a systematic and consistent approach, the regulatory body should develop internal guidance on the processes and procedures to be followed to carry out the regulatory functions in an effective and efficient manner as well as on the safety objectives to be met.”</i>
(2)	BASIS: GSG 13, para. 3.192. states that <i>“The regulatory body should provide internal guidance for its own staff on the procedures to be followed in the review and assessment process and on the safety objectives to be met. Internal guidance on specific topics for review and assessment should also be provided, as necessary.”</i>
(3)	BASIS: GSG 13, para. 3.193. states that <i>“The regulatory body should develop internal guidance on reporting on its review and assessment activities and on how it reaches its regulatory decisions. The regulatory body’s internal guidance on review and assessment should be made available to other regulatory authorities worldwide.”</i>
S10	Suggestion: The Federation and the Länder authorities should consider developing internal guidance for the review and assessment process.

Safety improvements identified during assessment

The safety improvements identified during assessments are voluntarily implemented by the licensee in a timely manner in Germany. The majority of safety improvements are not subject to re-licensing and can therefore be carried out by the licensee within the framework of the supervisory modification procedure. However, if necessary in exceptional cases, the licensee applies for a license to modify the installation or its operation accordingly.

Documentation produced by the regulatory body

Review and assessment results in a decision on the acceptability of the safety of the facility or activity, which may be connected to a step in the authorization process. The basis for the decision is recorded and documented in an appropriate form.

In general, TSOs (e.g. TÜV) perform the review and assessment and submit an expert report to the Länder Authorities. The Länder Authorities carry out a thorough review of the report and submit their official evaluation documents which describe the decision on acceptability of the safety of the facility or activity to BMU.

6.1.4. PERFORMANCE OF REVIEW AND ASSESSMENT

In order to provide assurance that all topics significant to safety will be covered consistently with submissions for similar facilities or activities, the regulatory body carries out the review and assessment by means of a systematic and formalized process implemented through specific procedures.

Integrated Safety Assessment

The IAEA GSR Part 1, para. 4.46 states that for an integrated safety assessment, the regulatory body shall first organize the results obtained in a systematic manner. The ISA is a structured and systematic safety evaluation that looks at the overall safety of operating nuclear installations in order to ensure continuous safe operation and to provide information to interested parties (for example, the government, the public and the international community).

In general, Integrated Safety Assessment (ISA) consists of three subsequent processes:

- Organizing results and data from inputs from ISA,
- Trend analysis and conclusions,
- Feedback to authorized parties.

The results and data from ISA inputs after having been organized need to be analysed and judged. For each of the safety areas considered in ISA, objectives/thresholds/acceptance criteria have to be set against which trend analysis is then performed. Irrespective of the form in which feedback is given, all relevant results from ISA should be provided.

The Länder authorities have carried out various regulatory activities to ensure the high level of safety in the nuclear power plants, such as:

- Preparation, execution and follow up process for maintenance and refuelling outages,
- Development of important items of review and assessment (e.g. condition and functioning of the installation, operating behaviour of the installation, and operating management and adherence to regulations),
- Review of annual report of safety management submitted by the operator, and
- Routine meeting with operators, etc.

Some of the nuclear licensing and supervisory authorities of the Länder use indicators to verify the safe operation of the installations (safety performance) of the licence holder and to align their activities accordingly. These safety performance indicators are partly established by the licence holder and reported to the competent licensing and supervisory authorities of the Länder.

The IRRS team observed that there have been several activities to ensure the high level of nuclear safety, however there is neither a written formal process nor a guidance on how to confirm the safety assessment in a systematic manner and how to integrate all the activities such as identification of the trends and conclusions, and feedback information to the operator etc.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *There is no formal written process or guidance on how to confirm the safety assessment in an integrated and systematic manner.*

(1)

BASIS: GSR Part 1 Requirement 26, para. 4.46. states that *“For an integrated safety assessment, the regulatory body shall first organize the results obtained in a systematic manner. It shall then identify trends and conclusions drawn from inspections, from reviews and assessments for operating facilities, and from the conduct of activities where relevant. Feedback information shall be provided to the authorized party. This integrated safety assessment shall be repeated periodically, with account taken of the radiation risks*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	<i>associated with the facility or activity, in accordance with a graded approach.”</i>
S11	Suggestion: The Federation and Länder authorities should consider developing a process for integrated safety assessment in a systematic manner for all facilities and activities.

6.2. REVIEW AND ASSESSMENT FOR NUCLEAR POWER PLANTS

According to the Atomic Energy Act, the safety review is mandatory for all nuclear power plants and supports the continuous improvement of nuclear safety as a supplement to the ongoing supervisory review. On the basis of the licence issued, the actual condition of the plant and the requirements of the state-of-the-art in science and technology, the safety status of a nuclear power plant must be holistically registered every ten years and assessed in a protection-goal-oriented manner by means of a safety review.

The information subject to regulatory review and assessment after a licence has been granted comes primarily from the following sources:

- From the findings gained in the context of supervision according to the Atomic Energy Act (regulatory inspections, records and reports by the licensee),
- From applications by the licensee for non-essential modifications of the facility or its operation,
- From the safety reviews that have to be carried out every ten years by the licensee,
- From events occurred in German installations that have been reported to the Incident Registration Centre,
- From information notices prepared by GRS on behalf of the Federation. The information notices also contain information on safety-related matters that have occurred worldwide.

Essential and non-essential modification

Essential modifications to an installation or its operation require licensing in accordance with the Atomic Energy Act. They are subject to comprehensive reviews and assessments by the licensing and supervisory body in the context of the licensing procedure. However, also non-essential modifications to an installation or its operation that do not require licensing are reviewed and assessed by the licensing and supervisory body in the context of supervision according to the Atomic Energy Act. The scope of the review and assessment follows their safety significance. The supervisory authorities are supported in this by authorised experts consulted according to the Atomic Energy Act.

Independent verification

IAEA GSR Part 4 Requirement 21 states that “an independent organization shall carry out an independent verification of the safety assessment before it is used by the operating organization or submitted to the regulatory body.”

No. 5.16 para. (4) KTA 1402, “Safety Analysis and Verification” is only considered with regard to the periodic safety reviews in accordance with the Atomic Energy Act. The licensee is required to perform an independent internal verification of the safety reviews. However, in Germany there is no comprehensive independent verification by the applicant or licensee as required in IAEA GSR Part 1.

6.3. REVIEW AND ASSESSMENT FOR RESEARCH REACTORS

The general requirements of the Safety Requirements for NPPs apply to RRs in Germany. In the supervision and licensing of RRs, the rules and regulations of NPPs are applied to the safety-relevant systems and components of RRs according to a graded approach.

There are few examples of guidance on how to apply the graded approach of the PSR to the FRM-II, and on the modification procedure according to the maintenance and modification regulations of the FRM-II operating manual.

The IRRS team observed that there is no clear written guidance how to apply the graded approach for the review and assessment for PSR to the RRs. This issue is discussed in detail in Module 9.

6.4. REVIEW AND ASSESSMENT FOR FUEL CYCLE FACILITIES

Fuel Cycle Facilities are licensed according to § 7 of the Atomic Energy Act and are subject to analogous requirements as those applicable to nuclear power plants. To ensure that the main safety functions are fulfilled, a licence can therefore only be granted if the applicant demonstrates that all prerequisites are met. In addition, review and assessment of the fulfilment of the regulatory requirements takes place within the framework of the nuclear licensing and supervisory procedures, in accordance with § 19 of the Atomic Energy Act and the Nuclear Licensing Procedure Ordinance (AtVfV).

According to the obligation to carry out nuclear safety reviews and assessments and to continuously improve nuclear safety of the facility, Periodic Safety Reviews are performed in accordance with the Atomic Energy Act every 10 years, in the case of UAG the last safety review has been carried out in 2011.

6.5. REVIEW AND ASSESSMENT FOR WASTE MANAGEMENT FACILITIES

Spent fuel storage facilities

Spent fuel storage facilities are licensed under § 6 of the Atomic Energy Act and the licence is generally issued for a period of 40 years. Periodic safety review of these facilities is performed every 10 years according to § 19 of the Atomic Energy Act. The Nuclear Waste Management Commission (ESK) issued a recommendation in 2014 which provided guidelines for the performance of periodic safety reviews and on technical ageing management for storage facilities for spent fuel and heat-generating radioactive waste facilities. These are defined as sub-statutory regulations and are made binding by publication in the Federal Gazette and/or incorporated into the licence.

Before construction, regulatory safety assessment is performed by BfE, the Federal licensing authority. Authorised experts in accordance with § 20 of the Atomic Energy Act are usually consulted as part of the reviews and assessments to provide expert support. On behalf of the regulatory body, the authorised experts carry out independent calculations, review design drawings, inspection plans and other documents, and prepare expert opinions and expert statements.

References for the design and operation requirements of dry storage facilities for spent fuel are provided by the “Guidelines for dry cask storage of spent fuel and heat-generating waste” of the Nuclear Waste Management Commission (ESK) of 2013.

In connection with dry storage, the internal events that generally have to be considered are mechanical impacts, such as the crash of a fuel assembly cask, collision of a cask upon handling, and the crash of a load onto the cask, and fire.

According to the guidelines, the external natural impacts and man-made impacts from outside that are taken into consideration are: external natural impacts such as storm, rain, snow, frost, lightning, flooding, landslides and earthquakes, and man-made impacts from outside such as the effects of harmful substances

(e.g. poisonous or explosive gases), blast waves caused by chemical explosions, fires (e.g. forest fires) spreading to the facility, mines caving in, and aircraft crashes.

Further impacts have to be taken into account depending on the conditions at the respective sites. For example, interactions with a neighbouring power plant are also considered, e.g. the collapse of structures, a turbine failure, or the failure of vessels with high energy content, as far as debris from such events may affect the storage facility.

During the construction and operation of the SF storage facility, the Länder, as supervising authority, performs review and assessment according to the Atomic Energy Act. For any deviation from the licensed status or operation of the facility that is considered as being substantial for the safety level at the facility, modification licences are applied for by the operator at the competent licensing authority, sometimes within the framework of an order issued by the supervisory authority.

Content of the safety documentation is provided in the “Guidelines for dry cask storage of spent fuel and heat-generating waste” (ESK) of 2013.

During review and assessment, a graded approach is applied. Based upon the supervisory regulatory review, a distinction is made between essential modifications requiring licensing and non-essential modifications that do not require licensing. In the case of SF storage facilities, except for high safety relevant modifications, where the applicant has to communicate the modification directly to BfE (as for instance the case of new inventory due to re-entry of vitrified waste from reprocessing), Länder evaluate if modifications are essential or non-essential. For essential modifications an amendment process of the license is then implemented by BfE.

Other waste management facilities

Under § 19a of the Atomic Energy Act operational disposal facilities and the Asse II mine have to be subjected to review and assessment of nuclear safety every 10 years. However, the operating licence for the Morsleben disposal facility requires review of overall safety every 5 years.

The Konrad disposal facility is currently under construction and so is not yet subject to the requirement for a 10-yearly periodic safety review under § 19a of the Atomic Energy Act. However, the relevant supervisory authority is involved in the review and approval of construction measures in accordance with the plan approval.

For other waste management facilities that are licensed under the Atomic Energy Act the periodic safety review requirement in the Act applies. Other radioactive waste management facilities are licensed under Radiation Protection Act. The Nuclear Waste Management Commission (ESK) issued a recommendation in 2013 which provides guidelines for the storage of waste with negligible heat generation. These also are defined as sub-statutory regulations and are made binding by publication in the Federal Gazette and/or incorporated into the licence. The guidelines indicate that the operator of the facility must perform a safety review of the facility every 10-years. The guidelines address requirements in the EU Directive on nuclear waste management and the relevant WENRA safety reference levels which Germany has implemented in national regulations. The guidelines provide information on what should be covered in the Periodic Safety Review, including consideration of long-term and ageing effects and monitoring of both the facility and the waste packages stored in the facility.

6.6. REVIEW AND ASSESSMENT FOR DECOMMISSIONING ACTIVITIES

The IAEA GSR Part 6 Requirement 4, para. 3.2. states that the government shall ensure that the necessary scientific and technical expertise is available both for the licensee and for the support of regulatory review and other independent national review functions.

In the self-assessment, it is indicated that “once having been granted the necessary licenses, nuclear installations are subject to constant state supervision in accordance with § 19 Atomic Energy Act during the entire service life, from their erection through operation to the termination of decommissioning and dismantling.

Decommissioning licenses are issued by the Länder authority and independent reviews of operator’s submittals are conducted by the TÜV, as technical support organisation. Independent reviews are conducted upon requests from the Länder authorities on a case by case basis under individual contracts. In practice, technical meetings are organized involving the Länder, the applicant and the technical support organization in order to set the time frame of the review process. The review process can be launched once the first safety documents have been submitted by the applicant and then a continuous process is implemented to consider any additional submittals. There is no time frame in the German legal and regulatory framework for the review process.

During the site visit for inspection at Neckarwestheim, the operator pointed out that the duration of the licensing process could take several years (3-4 years). It has been indicated that one license for Neckarwestheim 2 will be requested instead of two licenses as it is the case for the Unit 1.

In the context of the German nuclear phase out, the authorities expect an increase of licensing activities and the number of staff should increase accordingly. From the TSO point of view, all independent reviews will be considered on a case by case basis upon requests. All TSOs work independently from each other. There are no specific needs for technical coordination on the possible review findings regarding decommissioning for similar decommissioning projects in Germany. When required, the TSOs can request technical support to some identified other technical support organizations for specific field of expertise acting as sub-contractor.

The IRRS team observed that periodic safety reviews (PSRs) for nuclear power plants are not required for immediate dismantling. However, there is an immediate safety assessment during the authorization process. Every modification or change in plant condition which is not covered by this initial assessment needs to be assessed in a modification procedure. For a deferred dismantling strategy re-assessment is required every 10 years.

Regarding safety, the ESK guide on decommissioning indicates in the chapter 8 on safety that *“classification, reclassification and adaptations of safety-relevant installations to the changed conditions of dismantling require the performance of safety assessments and approvals by the supervisory authority”*.

Nevertheless, there is no requirement on how the licensee shall carry out at regular intervals a review of the safety of the facility under decommissioning and what should be the related frequency. No experience feedback arrangements are implemented to collect, screen, analyse and document experience and events at the facility in a systematic way to improve and ensure safe decommissioning. Relevant experience and events reported by other facilities should also be considered as appropriate.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *There is no requirement for periodic re-assessment of safety during immediate dismantling.*

(1)	BASIS: GSR Part 1 Requirement 26, para. 4.39A states that <i>“The regulatory body shall ensure, adopting a graded approach, that authorized parties routinely evaluate operating experience and periodically perform comprehensive safety reviews of facilities, ...”</i>
(2)	BASIS: GSR Part 4 Requirement 24 states that <i>“The safety assessment shall be periodically reviewed and updated.”</i>
(3)	BASIS: GSR Part 4 Requirement 12 states that <i>“The safety assessment shall cover all the stages in the lifetime of a facility or activity in which there are possible radiation risks.”</i>
(4)	BASIS: WS-G-5.2, para. 2.4 states that <i>“The safety assessment for decommissioning should be reviewed and updated, as appropriate, to ensure that it remains an accurate representation of the physical, chemical and radiological state of the facility as the decommissioning activities proceed.”</i>
R5	Recommendation: The regulatory body should establish requirements for the periodic review and update of safety assessments during immediate dismantling.

6.7. REVIEW AND ASSESSMENT FOR OCCUPATIONAL EXPOSURE

For NPP, the safety report is sent to the Competent Authority of the involved Land, who requests the TSO to evaluate it and provide an advice. This advice can give rise to license conditions. Occupational protection aspects are included in the safety report and additional documents.

The licensees for NPPs have to provide a monthly report to the regulatory body, which includes the radiation protection aspects, in particular concerning occupational protection. Additionally, the licensees have to provide a yearly report and reports after outages.

For other installations, the review and assessment process depends on the type of installation (graded approach). Occupational protection aspects are included in the review.

6.8. SUMMARY

The Regulatory Authority performs comprehensive reviews and assessments of all relevant information within the framework of its supervision.

The Länder Authority with the support of the TSO experts in Germany reviews the scope, calculation and evaluation methodologies and the safety analyses to verify compliance with the regulations on safety standards and regulatory practices, as well as specific requirements in the license conditions, including international benchmarking and other international practice.

In several areas of review and assessment there is potential for improvement in respect to:

- Procedure to perform Integrated Safety Assessment in a systematic manner to nuclear facilities
- Internal guidance in the review and assessment process to ensure that all the relevant safety requirements are met by the proposed design and operation of the nuclear facilities,
- Requirements for the review and update of safety assessments during immediate dismantling.

7. INSPECTION

7.1. GENERIC ISSUES

All nuclear installations in Germany are subject to continuous regulatory oversight over their entire lifetime from the start of construction to the end of decommissioning. The nuclear licensing and supervisory authorities of the Länder which, in the case of the Land of Baden-Württemberg, is the Ministry of the Environment, Climate Protection and the Energy Sector Baden-Württemberg (UM BW) on behalf of the Federation perform this supervision. Within the framework of supervision, the respective Länder with the assistance of authorised experts monitors compliance with the provisions of the Atomic Energy Act, the Radiation Protection Act, the ordinances under nuclear and radiation protection law and other nuclear safety standards and guidelines, compliance with the provisions, obligations and ancillary provisions imposed in the licence notices, and fulfilment of supervisory orders issued.

Supervisory authorities conduct mostly planned inspections that are announced in advance. UM BW carries out also unannounced inspections, even outside normal working hours, e.g. at night and at the weekend, to make sure that the working behaviour between the announced and unannounced inspections does not differ. The frequency of this measure depends on the type of installation. Additionally, reactive inspections are carried out following reportable events or safety-relevant findings. Inspectors have unlimited access to authorized facilities and activities. The standard way of dealing with safety significant findings is a formal letter sent to the licensee after the commencement of inspection. Inspectors have the right to verbally order on the spot to stop activities with safety implications and potential for risks. The verbal order is later confirmed in written form.

All inspection methods mentioned in the IAEA GSG-13 are utilized including monitoring, direct observation, discussions, reviews, examinations of procedures, records, and documentation. Independent sampling, tests, and measurements are conducted in the area of radiation protection and radioactive waste.

The competent nuclear supervisory authorities follow a graded approach that depends on the hazard potential. For example, due to the high hazard potential of nuclear power plants, the supervisory intensity at these installations is higher than for other nuclear installations (e.g. research reactors, storage facilities).

The principle of the licensee's responsibility is clearly stated in the Atomic Energy Act and the Radiation Protection Act. The supervisory authorities, therefore, check particularly, by means of appropriate sampling tools in the form of random checks, the extent to which the licensee complies with his own self-monitoring obligation.

The competent supervisory authorities perform their inspections on the basis of inspection programmes for installations and activities within their responsibility. The supervisory authorities pursue a holistic approach for all aspects of Man-Technology-Organisation and therefore focus on the entire installation and all activities. Furthermore, national and international findings are taken into account.

Some inspections are also performed in cooperation with other authorities (e.g. civil engineering) or institutions (e.g. industrial safety). These inspections are initiated on a case-by-case basis.

The competent nuclear supervisory authorities internally record the results of the inspections. If any findings have been established during the inspections or important insights have been gained, these are also addressed and discussed for the purpose of exchanging information within the scope of the routine divisional briefings and, where appropriate, at the meetings of the heads of the different divisions at the authority.

All results of inspections including the findings are communicated only orally to the licensee's personnel at the end of the inspections. Results of inspections are recorded, and findings are tracked in the UM BW

internal “VDV” database. In cases where weaknesses are identified in the licensee’s activities, the licensee is asked in the official letter to identify the causes and to provide remedial actions or improvements and to present these in a written report to the competent nuclear supervisory authority. This report by the licensee is then the subject and starting point for further supervisory activities. The content of inspection reports does not fully follow guidance given in the IAEA GSG-13.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>Arrangements for distributing of all results of inspections in inspection reports to the authorised party are not in place.</i>	
(1)	BASIS: GSR Part 1, para. 4.51 states that “The regulatory body shall record the results of inspections and shall take appropriate action (including enforcement actions as necessary). Results of inspections shall be used as feedback information for the regulatory process and shall be provided to the authorized party.”
(3)	BASIS: GSG-13, para. 3.287 states that “Inspection reports should be distributed, or made available electronically, in accordance with established procedures in order to provide the following: (a) A basis for future regulatory action; (b) A means of passing information to interested parties or governmental bodies;”
S12	Suggestion: The supervisory authorities should consider modifying internal guidance to ensure that all results of inspections are forwarded to the authorised party.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>Content of inspection reports provided to the IRRS team does not fully follow the guidance given in the IAEA GSG-13, references to applicable requirements and criteria used for the assessment are missing in the reports.</i>	
(1)	BASIS: GSR Part 1, para. 4.51 states that “The regulatory body shall record the results of inspections and shall take appropriate action (including enforcement actions as necessary). Results of inspections shall be used as feedback information for the regulatory process and shall be provided to the authorized party.”
(2)	BASIS: GSG-13, para. 3.286 states that “The inspection report should typically contain: c) reference to applicable requirements d) criteria used for assessment of safety performance
S13	Suggestion: Supervisory authorities should consider completing guidance on the

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

content of inspection reports.

7.2. INSPECTION OF NUCLEAR POWER PLANTS

Comprehensive inspection programme is in place for inspections at NPPs. In UM BW the programme is documented in “Supervision Concept (AK)”, and “Supervision Manual (AHB)” which includes also a set of inspection procedures. All inspection areas listed in Appendix IV to the IAEA GSG-13 are covered in the inspection program. Annual inspection plans derived from above-quoted documents are prepared for each NPP. During inspections, UM BW inspectors make observations on the operator’s safety culture. Since 2006, organizational and personal aspects of operator performance are recorded, documented and analysed through the use of the KOMFORT oversight tool (Catalogue for recording organizational and human factors during on-site inspections).

A recent R&D project by the GRS on behalf of the BMU resulted in a new tool MESKA which allows to assess the licensee’s safety culture focusing on the actions of the leaders. It supports both an en-passant approach (collecting HOF data during all kinds of on-site inspections) and an en-block, in-depth assessment of safety culture. It is the decision of the Länder how they apply MESKA in their inspection activities. As an example, HOF experts and site inspectors of Baden-Württemberg continuously improve their well-established tool KOMFORT. They implemented modifications based on MESKA, added examples due to decommissioning, and expanded the collection of safety culture aspects by observations also during other regulatory activities than inspections. A systematic approach to the assessment of safety culture level, updated with the use of R&D project results, is in the view of the IRRS team, an area of good performance of German authorities.

All common inspection types are described in the inspection programme for inspections at NPPs. Inspections are performed by Länder regulatory authorities in consultation with experts from TÜV to carry out technical checks and plant ‘walk downs’.

For inspection planning, there is a process at the UM BW that is outlined in the “Supervision manual (AHB)”. To ensure that findings from other supervisory activities (e.g. evaluation of the KOMFORT data or safety performance indicators) are considered in the inspection planning in a timely and systematic manner, the processes have been revised and better coordinated.

The graded approach is embedded in UM BW internal documents which are relevant for inspections. Inspectors are trained to pay higher attention to activities, structures, systems, and components of higher safety significance.

There are 8 inspectors dedicated to each NPP site involved in regulatory inspections, and also review and assessment and licensing activities in UM BW directorate 3. Inspection effort of UM BW division 33 which is responsible for oversight at Neckarwestheim NPP site was 64 - 72 man-days in 2017 and in 2018. Besides UM BW inspections, some of 160 TÜV Süd experts participated at approximately 1400 technical tests and inspections on behalf of UM BW in 2017. Participation of TÜV experts at these tests and inspections is prescribed in NPPs operating manuals. Presence of regulatory and TSO staff at NPP site appears to be in the view of the IRRS team appropriate.

To ensure the effective implementation of the inspection program and to enable the identification of significant safety issues, systematic training of Länder staff is implemented. The competence of inspectors is achieved through formal training programs. An inspector initial training program is in place, and every

inspector has an individual plan of specialized training, which includes on-the-job training for inspectors, knowledge of legislation, facilities and activities being regulated, internal processes and procedures, and other specific office skills. Annual refreshing training plans are prepared, including for experienced employees. These plans contain components such as knowledge of national legislation, participation at international training workshops and meetings. Appropriate technical competence and qualification of TSO experts are required in service contracts signed between Länder and TSOs. Detailed guidelines on staff qualification and training common for GRS and TÜV are in place since 2003. These guidelines are part of the contract between TÜV and Länder.

The IRRS team, with the goal to get insights on the consistency of inspection activities in other federal states, reviewed relevant chapters of “Handbook on Cooperation between the Federation and Länder in Nuclear Law”. Activities of Länder Committee (LAA) and several other committees and subcommittees are coordinated through the handbook. Minutes from the meetings of LAA are prepared by BMU. The LAA ensures sufficient consistency in inspection activities of Länder.

Results of UM BW inspections are analysed and discussed at weekly departmental meetings, all findings or experience from inspections relevant for further improvements of management system are recorded and used appropriately. Communication and coordination between Länder and federal level (BMU) is through the LAA.

The IRRS team reviewed “Supervision, monitoring, authorisation” document which defines also process parameters used for assessment of UM BW supervisory and inspection activities effectiveness. German counterparts confirmed that these process parameters did not indicate any deviations from expectations on effectiveness UM BW activities in 2017 and 2018. Based on the review of the process parameters and also on very good operational safety record of German NPPs, UM BW inspection activities appear to be effective.

Public and authorised parties are informed on UM BW evaluation of NPPs status at UM BW website. Information is published on each reportable event; detailed reports are available on more safety significant events. Summaries on results of UM BW supervision are given in monthly and annual reports.

The IRRS team visited Neckarwestheim NPP site and observed inspections performed by UM BW inspectors. For operating GKN unit 2, the IRRS team observed inspection performed by UM BW inspector. Programme of the inspection was divided into several parts, one focused on operational management, others focused on the general status of the plant equipment and housekeeping.

UM BW inspector used for inspection guidance provided in the “Supervision manual (AHB)”, which was sufficient for achieving the purpose of the inspection.

At the start of the inspection, the inspector visited the main control room and was informed on plant status by the shift supervisor. He was informed that a physician is on site because of the health problems of a worker and that emergency diesel-generator 50 is in W2-maintenance.

Inspector reviewed also shift log, parameters, and alarms of safety-related systems at system-panels, particularly emission-measurement, control of key-logs, and documents related to the periodic maintenance which was in progress on one of safety grade diesel-generators. He also reviewed the weekly plan of in-service tests and results of tests which were finished at the time of inspection. IRRS team asked for evidence of the involvement of TÜV experts for inspections, counterparts explained and demonstrated that in the reports of in-service inspection tests is the participation of TÜV experts confirmed if prescribed in the NPP operating manual.

The inspection continued in the controlled area of the reactor building, and at the other platforms at spent fuel pool level. At the reactor annulus, the safety measures for redundancy 1 has been checked.

The inspection continued to the emergency feed building. The maintenance of the diesel-generator 50 was supervised and documentation was reviewed. After that, the emergency control room was inspected and the records in the operating manual were checked. Outside the building, a mobile emergency diesel-generator was visually checked.

During the ‘walk downs’, only two minor findings were identified and communicated to the NPP staff during the exit meeting. The operator was informed at the end of the inspection about the results of the inspection. The IRRS team noted an outstanding level of housekeeping and status of all structures, systems, and components.

The IRRS team also discussed with EnBW Kernkraft GmbH managing director nuclear power plants, deputy plant manager, and several other managers their opinions on the relationship between regulator and licensees which they observed to be professional.

7.3. INSPECTION OF RESEARCH REACTORS

The research reactor Hochflussneutronenquelle München in Garching (FRM II) is situated at the premises of the Research Centre in Garching at the scientific institute of the Technical University of Munich (TUM). The FRM II provides a high neutron flux for science, industry, and medicine in four cycles of 60 days a year. Licensee of the FRM II is the Freistaat Bayern represented by the Bayerische Staatsministerium für Wissenschaft und Kunst and the TUM. The competent authorization and supervisory authority of the Länder for FRM II is the Bavarian State Ministry of the Environment and Consumer Protection (StMUV). Discussions with the representatives of StMUV during the IRRS mission revealed that inspections at FRM II are conducted through plant ‘walk downs’ either by the regulatory staff or by the technical support organization, as and when required or in response to events or on another technical basis since its first operation in 2005. TSO inspections are performed as required in the FRM II research reactor license. As part of developing a supervisory manual for FRM II, StMUV has started developing a comprehensive inspection programme, but this is still in draft. Discussion with BMU representative also revealed that BMU is not aware of any programmed inspection strategy on other research reactors in Germany since the responsibility for the regulatory oversight is with the respective Länder.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>StMUV inspections at FRM-II research reactors are performed on ad-hoc basis. Inspection plans and a comprehensive inspection programme for FRM-II research reactor inspections are in preparation.</i>	
(1)	BASIS: GSR Part 1 Requirement 28 states that <i>“Inspection of facilities and activities shall include programmed inspections and reactive inspections both announced and unannounced.”</i>
(2)	BASIS: GSR Part 1 para. 4.50 states that <i>“The regulatory body shall develop and implement a programme of inspection of facilities and activities to confirm compliance with regulatory requirements and with any conditions specified in the authorization, In this program, it shall specify the types of regulatory inspections(including scheduled inspections and unannounced inspections), and shall stipulate the frequency of inspections and the areas and the programmes to be inspected, in accordance with the graded approach.”</i>

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
R6	Recommendation: StMUV should develop a comprehensive inspection programme for FRM II research reactor by specifying inspection items, frequency for inspections and provisions for announced, unannounced and reactive inspections in accordance with the graded approach.
S14	Suggestion: BMU should consider developing a programmed approach to inspections for all research reactors in Germany.

7.4. INSPECTION OF FUEL CYCLE FACILITIES

For FCFs, as for other nuclear installations, the Länder authorities, as competent nuclear supervisory authorities, verify, according to § 19 AtG, throughout the period of operation, from construction to release from the Atomic Energy Act, whether or not the licensee complies with the regulatory requirements and the conditions laid down in the license.

The competent nuclear supervisory authorities may, in accordance with §20 Atomic Energy Act, consult authorised experts who are organized in technical support organizations (TSO) in supervisory and licensing procedures. The involvement of authorised experts and the requirements placed on them, in particular training, professional knowledge and skills, reliability and impartiality are regulated in § 20 Atomic Energy Act and § 20 Administrative Procedure Act (Verwaltungsverfahrensgesetz (VwVfG)).

At the Gronau Uranium Enrichment Facility (UAG), on-site supervisory activities take place regularly during normal operation by the Ministry of Economic Affairs, Innovation, Digitalisation and Energy of the State of North Rhine-Westphalia (MWIDE). The Ministry monitors, in particular, compliance with the provisions of the Atomic Energy Act, the ordinances issued under nuclear law and other safety standards and guidelines, compliance with the conditions of the licences and compliance with supervisory orders issued. The Ministry monitoring is implemented, in particular, by the inspections carried out or accompanied within the framework of regulatory supervision (announced and unannounced), operational meetings, repair sheet meetings, modification meetings (ongoing operation), project meetings (construction), safety committee meetings, the tracking of in-service inspections (ISIs), and function and acceptance tests and control measurements and waste product controls.

The results of the supervisory inspections are recorded in a technical report, in which, in addition to the scope of the inspection, any deviations found are recorded, if necessary with a deadline for their elimination. The MWIDE is informed by the licensee about the elimination of the deviations. In addition, there is a list showing an overview of respective inspections and dates and the plant components and systems covered by the inspection to ensure that the entire plant was inspected at regular intervals.

7.5. INSPECTION OF WASTE MANAGEMENT FACILITIES

In Germany, inspections of nuclear installations and of storage and disposal facilities are conducted by the competent supervisory authorities on the basis of the Atomic Energy Act. The corresponding inspections in this respect are carried out by the respective competent Länder licensing and supervisory authorities.

Inspection at spent fuel storage facilities

BfE is the licensing authority for spent fuel storage facilities, and the Länder authorities, as competent nuclear supervisory authorities, verify, according to § 19 AtG, throughout the period of operation whether or not the licensee complies with the regulatory requirements and the conditions laid down in the license.

According to ESK guidelines, periodic safety checks and aging management work for spent fuel and heat-generating radioactive waste storage facilities and for dual-purpose casks, as well as for all mechanical, electrical, cabling and communications installations at the storage facility, are all subject to regular inspection and maintenance.

Relevant stipulations are included in the facility operating and test manuals. To monitor the long-term safety of the building and the building aging, regular recurring visual checks take place. The results from these tests and checks are made available to the nuclear supervisory authority and are documented and analysed in the context of the periodic safety checks.

The competent nuclear supervisory authorities may, in accordance with §20 Atomic Energy Act, consult experts in technical support organizations (TSOs) during supervisory and licensing procedures.

TSO experts can be commissioned for almost all technical matters to assess the safety of the installations and their operation. The use of TSO experts does not, however, delegate responsibility for supervision.

Even though the IRRS team has been informed that in the state of practice communications exist between BfE and Länder authorities, there are no provisions in the regulations to ensure, that for dry cask spent fuel storage facilities, the licensing authority (BfE) is informed by the supervising authority (Länder) of the outcomes and findings from inspections. Considering that the period of operation of dry cask storage facilities could last over 40 years, given the real possibility that the operators will have to apply for extension of the authorized storage period, it is considered important to include provisions in the regulatory system such that the licensing authority is properly informed of the outcomes and finding from inspections carried out by the supervising authority.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *There are no provisions for the transmission of the outcomes and findings from inspections of dry cask spent fuel storage facilities from the supervising authority to the licensing authority.*

(1)	BASIS: GSR Part 1, para. 4.51 states that <i>“The regulatory body shall record the results of inspections and shall take appropriate action (including enforcement actions as necessary). Results of inspections shall be used as feedback information for the regulatory process and shall be provided to the authorized party.”</i>
(2)	BASIS: GSR Part 1 Requirement 7 states that <i>“Where several authorities have responsibilities for safety within the regulatory framework for safety, the government shall make provision for the effective coordination of their regulatory functions, to avoid any omissions or undue duplication and to avoid conflicting requirements being placed on authorized parties”.</i>
(3)	BASIS: GSG-13, para 3.287 states that <i>“Inspection reports should be distributed, or made available electronically, in accordance with established procedures in order to provide the following:</i>

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	<i>a) A basis for future regulatory action;</i> <i>d) Information to other staff of the regulatory body, for example those staff responsible for the development of regulations and guides, for review and assessment, and for the development of requirements for authorization;”</i>
S15	Suggestion: The BMU should consider revising the regulatory framework to ensure that the supervisory authorities (Länder) provide results of inspections to the licensing authority (BfE) for dry cask spent fuel storage facilities.

In instances, where there are no available disposal routes operating, storage may be necessary for considerable periods of time before disposal facilities become available. Waste shall be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management.

There are provisions for the regular monitoring, inspection and maintenance of the waste and of the storage facility to ensure their continued integrity. The adequacy of the storage capacity has to be periodically reviewed.

During the site visit, the IRRS team observed a regulatory inspection performed by the supervisory authority from Baden-Württemberg at the Neckarwestheim NPP site on radioactive waste management. The radioactive waste management inspection involved both the NPP operator, EnBW, and BGZ because of the transfer of responsibilities from EnBW to BGZ for operation of the onsite interim storage facility for spent nuclear fuel. An agenda for the inspection had been established by the Inspector and included specific checks to see if operating instructions were being implemented in a timely manner. The inspection also included a ‘walk down’ of the interim storage facility. Due to the context of transition between EnBW and BGZ, it was observed by the Inspector that some operating documents will need substantial updates. The inspection showed that the operators have anticipated and been preparing for the progressive transfer of responsibilities between them and for the related tasks to be undertaken to ensure in the future a clear separation between their roles and responsibilities, particularly in the area of physical security and access controls. The inspection was conducted in accordance with the authority’s supervision manual for on-site inspection. As indicated in the supervision manual, because the findings of the inspection were considered to have no influence on the safe operation of the facility, only verbal feedback was provided to the operators during the exit meeting.

Beyond the findings given in Sections 7.1 and 7.3, the IRRS team identified no further findings specific to the inspection of waste management facilities.

7.6. INSPECTION OF DECOMMISSIONING ACTIVITIES

All nuclear installations in Germany are subject to continuous regulatory oversight over their entire lifetime from the start of construction to the end of decommissioning. A comprehensive inspection programme is in place for inspections at NPPs, including those under decommissioning.

During decommissioning, the licensee shall maintain an up to date list of structures, systems and components important to safety. Such structures, systems and components can progressively be declassified and dismantled as the decommissioning progresses, provided that the facility’s inspection and maintenance programme is updated accordingly.

During the site visit, the IRRS team observed a regulatory inspection performed by the supervisory authority from Baden-Württemberg at the Neckarwestheim NPP site on the topics of decommissioning. In the decommissioning inspection, the IRRS team observed the inspection of certain work being conducted as part of the decommissioning of Unit 1 at the Neckarwestheim NPP. The inspection had been well planned and was conducted according to the supervision manual and followed a defined agenda. It focused on areas related to modification procedures, operational management and decommissioning (the latter was a new area added to the supervision manual in 2018). The inspection concerned the arrangements for decommissioning of a redundant emergency cooling system. The inspection worked progressively through the proposed decommissioning process, including its planning and associated documentation, checks that the power supply to the cooling system would be separated from the operating NPP Unit 2, checks and discussions with operator staff in the control room, examination of labelling of electrical switch gear and of coolant pipework, observations of physical decommissioning work (pipe removal), checking of the room information point where the physical work was being conducted, checks of housekeeping, and examination of the collection and segregation of waste for clearance or waste storage. There was evidence of good professional relations between the inspector and operator staff. There was also evidence of appropriate radiation protection measures and a good safety culture at the NPP. The inspector was clearly knowledgeable about the plant, the proposed work and its context in the wider regulatory framework. At the end of the inspection the Inspector provided verbal feedback to the operator.

Beyond the findings given in Section 7.1, the IRRS team identified no further findings specific to the inspection of facilities under decommissioning.

7.7. INSPECTION OF OCCUPATIONAL EXPOSURE

Responsibility for inspection is at the level of the Länder. Each federal state may organise inspection in their way. In some Länder, inspections for all types of installations are performed by the Ministry of environment itself. This is the case for example in Schleswig-Holstein, where the Ministry of environment has also a division that inspects medical and industrial installations. In most Länder however, inspection for practices not regarding the nuclear industry is further delegated to regional or local competent authorities, but supervised by the Ministry for environment of the corresponding Land.

Occupational radiation protection is systematically included in inspections of NPPs. A dedicated inspector inspects these aspects. Some of the Länder have issued an inspection programme but in general there are no rigid rules for frequency, but generally, inspections take place every 2 to 3 months. During these inspections, special topics are discussed with the licensee. Twice a year, the inspectors walk also through the controlled areas together with the technical expert of the TSO. Additional visits take place in case of a special activity (such as change of nuclear fuel). Guidance and KTA guidelines are used for inspection, which ensures a certain uniformity between the Länder.

In general, the radiation protection program (§45 of Radiation Protection Ordinance), including organizational, procedural and technical arrangements, delineation of controlled and supervised areas and periodic review is verified during the inspection. NPPs have a radiation protection manual (Strahlenschutzanweisung or Strahlenschutzordnung). Compliance with these programs and manuals is verified during inspections. The radiation protection program and manual are part of the licensing process. Additionally, the inspector and the technical expert check and approve any modification in the radiation program or manual according to the modification process. Additional procedural guidelines are applied for graded approach. Some minor changes that have no influence on radiation protection do not have to be notified, while changes that influence radiation protection have to be evaluated by technical expert and the Competent Authority. The latter changes constitute a foundation for an inspection, during which compliance with these rules is verified.

Planning of specific tasks, with prior dose estimation, is also discussed during inspection. If a specific task is expected to lead to a collective dose of more than 25 mSv, based on expected dose rates and timing of the work, detailed planning has to be provided and approved by the competent authority. Tasks that may imply a collective dose between 1 and 25 mSv, are also discussed between the operator and the regulatory body. For tasks that have a collective dose under 1 mSv, no specific planning is required, unless it will take place under very difficult conditions. Special protection equipment is obligatory, if the working conditions are disadvantageous for instance, to prevent incorporation, in case of high dose rate, or for workplaces difficult to access. However, such an individual dose above 6 mSv in a year is very seldom. Individual doses seldom exceed 2~3 mSv.

Monitoring programmes are also verified during the inspection. In controlled areas of NPPs, dose and dose rate measurements are performed at several locations, the results of which are available on a room plan on the computer. In controlled areas with higher dose rate, dose rate measurements are permanent. Next to the local doses and dose rates measurements, workers also have to wear individual dosimeters (an official dosimeter, and an alarm dosimeter with direct dose display).

The technical expert (TSO) validates the measurement methods and verifies equipment and measurements (variations and evolution over the years), according to KTA 1202 and KTA 1301.2 guideline, which sets the frequencies of testing by the expert and by the plant. The competent authority receives the results in the form of a summary report.

For outside workers, a delimitation agreement has to be established between the licensee and the external employer (which also has to have a license if his employees perform tasks that could lead to an effective dose of more than 1 mSv/year). The contract explicitly states that the external workers have to follow the instructions of the radiation protection executive of the plant. External workers receive the same dosimeters as the workers of the plant. When they finish their work, the radiation protection supervisor writes the dose in their radiation passbook, i.e. the operational dose if there is a non-complete month. Dose records are stored.

Neutron dosimeters are not worn in routine but they are available and used for specific tasks. This is also the case for ring dosimeters and eye lens dosimeters. The necessity to wear any of these is evaluated during planning of the task or per room.

Workers receive instructions and information and training about the use of PPE, use of monitoring equipment, cooperation with the employer/licensee. Records are kept on this information and training. All workers, including outside workers, receive a basic radiation protection information in a film of ~2h. Usually this information is in German. Translation in other languages is in development. The new legislation stresses that the information has to be given “in a language that is understood”. Language issues may arise; however, the plant has an interest that everything goes well and therefore ensures that the workers have understood the instructions. A technical expert supervises the worker.

For each task/workplace, a checklist exists with all the standard conditions for radiation protection (including training), as well as general occupational safety aspects, fire hazards. The checklist has to be signed by the radiation protection supervisor.

Radiation protection personnel receive more intensive training by the radiation protection supervisors and in training courses.

Testing and storage of PPE is the responsibility of the RP Executive. Radiation protection staff has to verify the good functioning of the PPE. In some cases, the technical expert is involved. In case of problems, the technical expert calls the competent authority.

Health surveillance information (date of the examination and conclusion on medical fitness) is recorded in the dosimetry system. For outside workers, this information is recorded in the radiation passbook, and upon contracting, entered in the dosimetry system. If the health surveillance examination has not been performed, the dosimetry system doesn't allow the worker to enter the controlled area. During an inspection, random sampling is performed.

In the NPPs and also in other nuclear installations there are plant specific dose thresholds. For example, in an NPP in Schleswig-Holstein, a worker with a dose of more than 15 mSv will not be allowed to access the controlled area (automatic check-in dosimetry system). The radiation protection supervisor can overrule this on an individual basis but only with good motivation as long as the dose limit is complied with. If the daily internal dose constraint of 0.5 mSv is reached, access to the controlled area is blocked and verification is done by the radiation protection supervisor. Similar internal thresholds are in use in other NPPs.

Only a few female workers work in controlled areas of NPPs. Pregnant and breastfeeding workers are excluded from controlled areas. For internal pregnant or breastfeeding workers, alternative employment is arranged. Protection against dismissal is regulated by the Maternity Protection Act.

In the case of ceasing of activities, radiation protection becomes more important during decommissioning. Therefore, the frequency of inspection will be higher in this case. The contents of these inspections will cover the same aspects.

7.8. SUMMARY

The IRRS team concluded that there is a sufficient legal basis for the regulatory authorities to carry out regulatory inspections in accordance with relevant IAEA Safety Standards.

- Regulatory authorities' inspections are planned and performed in such a way that an acceptable level of assurance that regulatory requirements is achieved.
- Inspectors and TSO experts are well qualified, motivated to discharge their duties, and respected by inspected organisations.

A systematic approach during inspections to the assessment of safety culture level of the authorized parties, updated with the use of R&D project results, is in the view of the IRRS team, an area of good performance of German authorities. The IRRS team identified some areas for improvement of the inspection process and provided suggestions in applicable areas of regulatory body practices, namely for updating of internal guidance on the preparation of inspection reports and for communicating of inspections results to authorised party.

8. ENFORCEMENT

8.1. ENFORCEMENT POLICY AND PROCESS

The Basic Law for the Federal Republic of Germany, Articles 73, para. 1, 85 and 87c empower the Länder to exercise state powers and to perform state functions in the field of use of nuclear energy and radiation protection, which also include enforcement.

Particular legal enforcement actions are specified in the Atomic Energy Act:

- Revoke a license - Atomic Energy Act, § 17, para 2-5;
- Suspend a license, shut down a facility or stop an activity – Atomic Energy Act, § 19, para 3, item. 3;
- Set additional conditions in the license - Atomic Energy Act, § 17, para 1;
- Impose fines - Atomic Energy Act, § 24 provides the Länder with the overall supervision responsibility, including enforcement powers. The governments of Länder transferred this responsibility to the responsible Ministries. For the federal state of BW, by the ministerial internal rules this responsibility was assigned to the “Directorate General 3 Nuclear Energy Supervision, Radiation Protection”. Fines are posed by this directorate general by an administrative procedure (by letter) while individual inspectors have not been granted the authority to issue fines. Fines are defined by § 46 of the Atomic Energy Act;
- Possibility to require additional safety analysis - Atomic Energy Act, § 19, para 2;
- Possibility to require modifications of a facility – there are no direct texts on that in the Atomic Energy Act. However, this is ensured through the powers provided by the Atomic Energy Act, Article 19, para 3 “Issue Corrective Order” or by modification of a license condition according to the Atomic Energy Act, § 17, para 1.

Additionally, the Radiation Protection Act provides for the powers for the following enforcement actions:

- §194 administrative fines
- §195 confiscation of items
- §74 revoking of certification
- §179 in connection with §17 Atomic Energy Act withdrawal or revoking of a license, including the license of major sources or of cross-border-shipment of consumer goods
- §§ 18, 20, 22, 26, 51, 57 prohibition of a notified operation (X-ray equipment; certain installation for generation of ionising radiation; aircraft; spacecraft; workplaces with exposure from naturally occurring radioactivity)

All criminal offences are managed according to the Criminal Code, including prosecution and imprisonment.

The TSO experts appointed by the competent authority are not empowered to take any enforcement action. The process is managed by the Länder, as TSO experts are obliged by the Service Contract to report immediately to the supervisory authority any safety significant facts or findings. This is done through the TSO’s duty officer to the RB duty officer (both available 24/7). Depending on the significance of the non-conformance, the RB could decide on the urgent need of an immediate authority action. When needed, on technical issues RB may request the authorized expert to verify that the deficiency had been timely and properly addressed.

There is no basis in the Atomic Energy Act for other (informal) enforcement tools, consistent with a graded approach, such as verbal/written notification, written warnings, etc. The Administrative Procedure Code provides the Länder with the powers and responsibilities to define their own approach to enforcement. IRRS

team was informed that when complying with the legal requirements and principles of the Federal Law, the available enforcement toolbox of the RB would not differ much in the different Länder.

Some of the Länder have established their own enforcement policies and practices, as part of their internal procedures (e.g. UM BW supervision manual and concept) or part of other internal documents, while others have not. This may lead to application of different enforcement approach when responding to non-compliances of licensees located in different Länder.

As the principal objective of enforcement is to provide a high level of assurance that licensees comply with safety requirements and license conditions, the application of enforcement actions by all regulatory authorities (federal and Länder) needs to be consistent and systematic. This could be achieved by providing appropriate guidance at federal level. By issuing a unified enforcement policy and respective guidance for its implementation, the regulatory authorities both at federal and Länder level will improve openness and transparency, allowing both licensees and the public to better understand how their enforcement decisions are made and what the respective criteria are.

Consistency in enforcement could be achieved in various ways, including for example the exchange of experience and practices in the LAA and joint training activities.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>There is no overall enforcement policy for all regulatory authorities to ensure consistency in application of enforcement actions to different licensees.</i>	
(1)	BASIS: GSR Part 1 Requirement 30 states that <i>“The regulatory body shall establish and implement an enforcement policy within the legal framework for responding to non-compliance by authorized parties with regulatory requirements or with any conditions specified in the authorization”.</i>
(2)	BASIS: GSG-12, para 3.26 states that <i>“The regulatory body is required to establish a regulatory system for safety that includes:</i> <i>(d) Enforcement of regulatory requirements; the regulatory body should adopt clear administrative procedures and guidelines governing the use and implementation of enforcement actions.”;</i>
S16	Suggestion: The BMU should consider measures to ensure promoting the consistency in the enforcement policies and practices at the various regulatory authorities.

8.2. ENFORCEMENT IMPLEMENTATIONS

The implementation of the enforcement policy and enforcement actions was discussed in detail with representatives of UM BW as example of Länder authority. All prerequisites of a sustainable enforcement policy, including the graded approach to enforcement, are defined in the various chapters of the Supervision Concept and Supervision Manual, however this RB did not establish a separate policy document on enforcement.

The Supervision Concept, Section 8, describes the enforcement policy and related powers of inspectors, including the right of discretion in imposing enforcement measures and the principle of proportionality. It clearly explains the main goal of enforcement (ensuring safety and compliance) and promotes the use of non-punitive (non-coercive) enforcement tools, called “informal administrative actions”. The provided interpretation of related legal provisions further support the proper selection of the enforcement tools and the application of a non-blame policy.

The UM BW enforcement policy is further developed in the Supervision Manual. Section MS-AH-400-R “Supervision, monitoring, authorization” of this manual defines the categories of licensee non-compliances and further explains the enforcement policy and practices. Four categories of non-compliances are defined:

- Deficiency 1: Functions or integrity of safety-related SSC are no longer guaranteed;
- Deficiency 2: Functions or integrity of safety-related SSC are degraded;
- Deviation: Functions or integrity of safety-related SSC are insignificantly influenced;
- Comment: Findings do not fall in one of the above categories but can contribute to improvement of safety or safety culture.

To each category of non-compliance, section MS-AH-400-R of the manual assigns a recommended enforcement action, thus giving the criteria for the application of non-legal enforcement actions appropriate to the severity of the non-compliance. The recommended approach does not prevent the inspector to exercise its right of discretion and other approach may be used according to the particular circumstances.

UM BW non-legal enforcement tools comprise of:

- Cooperative administrative actions – these include “preliminary negotiations”, “coordination activities”, discussions and agreements. These enforcement tools are considered exceptions from the recommended intervention practice but have led to quite good results during the past years;
- Non-formal administrative actions - these include verbal warning at different levels and communication of inspection findings following an inspection;
- Formal administrative actions - letters with the documented verbal comments made on-site, letters with inspection findings with the deadline for the corrective actions also included.

These enforcement actions are directly focusing on improvement of facility’s Structures, Systems and Components (SSC) as well as licensees’ procedures and practices without the need to impose legal enforcement actions (civil penalties or corrective orders). Expectations of the regulatory authorities refer to the licensee good safety culture and intelligence to comply with the safety requirements and take prompt actions to resolve any arising issue. Criteria on the selection of enforcement measures are supported by the consideration of the following factors:

- the safety significance of the non-conformity;
- the type and scope of the non-conformity;
- non-conformity recurrence;
- whether the non-conformity is deliberate;
- whether the operator/licensee has attempted to hide the non-conformity;
- whether the non-conformity has been identified and reported by the licensee;
- the feedback from other supervisory activities with that licensee.

The Supervision Concept and the Supervision Manual explain and promote the application of a graded approach in enforcement “the choice of enforcement actions by the supervisory authority is oriented by the safety significance” and provides sufficient guidance for its application. However, as already mentioned above, the good arrangements of UM BW in enforcement is not transferred to all Länder and some guidance at the federal level would support that process (state of Bavaria has already prepared a draft).

IRRS team was provided with the statistics of the enforcement actions taken by the UM BW for the last years. There has been only one case of a monetary fine to an individual in 2004 and only two changes to license conditions, both in 2003. Additionally, UM BW has issued 5 corrective orders (the latest in 2016). The mostly used enforcement measures are verbal warnings (15 for the last two years) and improvement letters (16 for the last two years). Those facts demonstrate the effectiveness of the implemented enforcement policy and the proper selection of the enforcement tools. As this is not unique for the international nuclear community, it could not be categorised as good practice according to the IRRS guidelines but indicates an area of good performance of the organisation.

For significant violations the UM BW has established internal processes and procedures on how to handle such situations. The justification of the need for a significant enforcement action is done by the inspectors and experts from the respective division. As those actions can be appealed against in court, the draft of the enforcement action is reviewed by and agreed with the legal division. As required by the Administrative procedure Act, Article 28 when the draft is ready it shall be subject of a “hearing”. This hearing provides the licensee with the opportunity to present its point of view. Final decision is signed by the head of “Department Nuclear Supervision, Radiation Protection” and send to the licensee by a letter. The licensee has the right to appeal against the decision in court. As the guiding legal principle in the German legal system is that the appeal stops the implementation of the decision (suspensive effect), UM BW has been given the powers to issue “Immediate execution orders”. The appropriate justification on the direct risk to the public interest has to be provided in such cases.

Concerning prosecution, the UM BW and Bavarian StMUV have signed a Memorandum of Understanding (MoU) with their prosecution authorities. The MoUs ensures the common understanding of parties on the processes, procedures and allocation of responsibilities in respect of the legal and technical aspects of the prosecution. The primary objective of the MoU is to describe the interfaces (flow of information, communication channels, etc.) between the organisation involved and their respective tasks. During the process of preparation of the MoU, competent authorities had numerous meetings and discussions on the best approach to enhance the process. This resulted to added value for both organisations, while such results could hardly be achieved by issuing a Governmental ordinance or a regulation. As in the area of nuclear supervision, criminal proceedings are not routine but are quite rare, the efforts of all parties involved to ensure the clear allocation of responsibilities, to define the process, and to get the expert preparedness for the proper and effective management of such situations is an area of good performance.

According to the IAEA Safety Standards, guides on enforcement need to indicate other governmental organizations that have to be informed following an enforcement action (particularly true for significant enforcement actions). The UM BW Supervision Concept and Supervision Manual has a specific section on informing third parties. However there have been no specific activities to identify other organisations that need to be informed in cases of license revocation, new condition in the license, discontinuation of activities, etc. UM BW would further benefit if possible addressee for communication following an enforcement are identified in advance and arrangements are made for their prompt informing.

IAEA guidance on enforcement suggest that imposing penalties on the licensee rather than on individual workers is preferable as is more likely to lead to improved safety performance. IRRS team discussed the respective guidance with UM BW and identified that this is not indicated in the German regulatory policy and practices. Furthermore, the overall German legal system is designed in such a way that responsibilities are clearly allocated to individuals, who are held responsible for any violation. The IRRS team identified that historically there had been only one monetary penalty issued to an individual (in 2004). This leads to the conclusion that, even the adopted enforcement practices are not completely adhering to the IAEA guidance, there is no risk for demotivation and degradation of safety culture of the licensee staff because of too many personal penalties. Additionally, the Act on Regulatory Offence allows fining both individuals

and companies, and when the analyses of human and organisational factors clearly indicate the organizational responsibility, the fine may be given to the organization (licensee).

Concerning recording of enforcement actions, UM BW did not establish a specific database of its enforcement decisions. Those are mostly kept on paper in the archives. However, all corrective actions coming from those enforcement decisions are included in a Regulatory Oversight Database (VDV). Once being recorded all open issues are monitored for their implementation. Implementation progress of an open issues needs to be reported by the licensee and further inspections could be carried out to verify that the open issue is closed. Enforcement records and the related supporting documentation is kept and archived in a way that allows easy access when required.

Enforcement decisions are not used as a safety performance indicator as the number of such decisions is extremely low and does not provide the possibility for any statistical trending or interpretation. However, the enforcement process and results are captured in the system of performance indicators through the analyses of VDV database. Additionally, UM BW is working on improvement of its system to assess the effectiveness of licensee corrective actions.

Finally, UM BW staff are periodically trained on enforcement as part of the annual retraining programme. This is not limited to enforcement presentations but also includes case studies and related discussions.

8.3. SUMMARY

UM BW has established adequate procedures and practices in the area of regulatory enforcement. The selection and implementation of enforcement actions and the signed MoU with the prosecution authorities of BW and Bavaria are considered areas of good performance.

All regulatory authorities in Germany would benefit from a more proactive attitude by BMU in promoting the consistency in the enforcement policies and practices at the various regulatory authorities. Consistency in enforcement policies and available enforcement tools would support that all licensees are treated equally with respect to enforcement.

9. REGULATIONS AND GUIDES

9.1. GENERIC ISSUES

The hierarchy and essential points of regulations and guides in Germany is summarized with categorization in chapter 1.1 Fig. 1.

Supported by the BfE and the Länder, the BMU continuously monitors developments in the field of nuclear safety by actively participating in the work of international, national, multi-national and bilateral committees and institutions.

Detailed activities in international level and national level are described in chapter 2.1.

The results of the work of these committees, working groups, federally funded research programmes, international regulations, research and development projects, and specialist contacts are drive the process of continuous improvement of safety regulations and guides.

A key guideline is the Handbook on Cooperation between the Federation and the Länder in Nuclear Law. This applies to the area of nuclear power plants with operating licences and outlines the relationship between federal oversight and the nuclear supervisory authorities of the Länder.

The periodic review process for the Safety Requirements for Nuclear Power Plants is carried out every five years stipulated in the Process 22 on the Handbook. The periodic review process for KTA Standards is stipulated in *the Legal Basis and Procedures* (KTA-GS-63). This document also states that KTA guides are reviewed at least every five years, and how interested parties should be involved. For decommissioning, in accordance with the paragraph 3 of the section 7 in the Atomic Energy Act, decommissioning of a nuclear power plant needs a license. The decommissioning guide shall be applied in this licensing process, and, by virtue of a decision of the Länder Committee for Nuclear Safety, adopted its application at Federal and Länder level.

The KTA safety standards are focused on the regulation of NPPs, and do not provide specific guidance for other nuclear installations. However, the regulatory authorities ensure that the KTA standards are taken into account in the relevant procedure also to supervise these other sites. The future of KTA beyond the phase out of nuclear power in 2022 is currently discussed within the KTA. There is a common understanding within the KTA on the need to maintain the KTA after 2022. The KTA has specified in its 2018 annual report that the number of KTA safety standards that are being revised has decreased substantially. However, the KTA made a survey among users of its safety standards about their importance after 2022. Of the identified 90 KTA safety standards, none are regarded as dispensable. The KTA regards 22 rules as very important, 38 as important, 17 as less important, and 13 as relatively unimportant. For nuclear power plants, 60 are regarded as remaining necessary as long as there is any fuel on site. A total of 38 KTA safety standards will remain important even beyond the year 2027. For intermediate storage sites and final repositories as well as transport, 46 rules remain necessary.

Periodic Safety Review

Reviews and assessments for nuclear facilities are carried out by the Länder Authorities assisted by TSOs as shown in chapter 6. However, responsibility for developing regulations and guides for review and assessment is in BMU.

The Guide for Periodic Safety Review has not been revised since it was published. The IAEA SSG-25 on the PSR suggests considering 14 safety factors for the review of the PSR. The IRRS team noticed that, in general, the Länder authorities have considered and implemented most of the safety factors in their review and assessment process of the PSR. However, some factors in IAEA SSG-25 such as safety performance,

organization, management system and safety culture have not been fully implemented during the review process of the PSR for NPPs and other facilities.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
<p>Observation: <i>In general, the Länder authorities implemented most of the safety factors in their review and assessment process of the PSR. However, the BMU guidance for implementation of periodic safety does not explicitly address some factors such as safety performance, organization, management system and safety culture.</i></p>	
(1)	<p>BASIS: SSG-25, para. 2.12. states that “A PSR should provide a comprehensive assessment of the safety of the nuclear power plant. Since the complex process of conducting a PSR can be aided by appropriate subdivision of tasks, this Safety Guide sets out these tasks in accordance with 14 safety factors.”</p>
S17	<p>Suggestion: BMU should consider updating its PSR guidance to address all safety factors with a graded approach in view of its future application for all nuclear facilities.</p>

9.2. REGULATIONS AND GUIDES FOR NUCLEAR POWER PLANTS

The Safety Requirements for Nuclear Power Plants

The Safety Requirements for Nuclear Power Plants (2015) applies to installations that are used for the fission of nuclear fuels for the commercial generation of electricity and to research reactors. These requirements contain fundamental and overriding safety-related requirements within the framework of the sub-statutory guidance instruments. They are mainly developed based on SSR-2/1 (2012), SSR-2/2 (2012) and WENRA Safety Reference Level for Existing Reactors (2014). They incorporate lessons learnt from the Fukushima Daiichi NPPs accidents. This safety requirement is reviewed every five years, which is stated in process 22 on Handbook on Cooperation between the Federation and the Länder in Nuclear Law.

In addition to the Safety Requirements, there are also explanatory and specifying “Interpretations of the Safety Requirements” which were adopted by the Länder Committee on Nuclear Energy (Main Committee) in 2013, meaning there is, a uniform execution of the Safety Requirements.

KTA safety standards

The KTA safety standards pertain to organisational issues, industrial safety, civil engineering, nuclear and thermal-hydraulic design, issues regarding materials, instrumentation and control, monitoring of radioactivity, and other provisions. Special focus is placed on quality assurance and quality management which is addressed in most of the safety standards.

KTA safety standards are also applied analogously to other nuclear installations, such as research reactors or pre-disposal and disposal facilities, and fuel facilities. The application of the KTA safety standards depends on the hazard potential of the respective installation and is performed by the nuclear licensing and supervisory authorities of the Länder in a graded approach.

The KTA issues nuclear safety standards in the area of nuclear technology. The KTA is comprised of representatives of manufacturers and operators of nuclear power plants, of TSO experts and state officials. Any changes to standards must gain consensus of the members.

KTA safety standards are not legally binding, but due to the nature of their origin and high degree of detail they have a far-reaching practical effect. The safety standards are revised to keep pace with changes in science and technology. The existing texts of standards are thus reviewed at least every five years.

Industry

The conventional technical rules apply, as is the case for the construction and operation of all technical installations, in particular the system of national standards of the German Institute for Standardization (DIN), regulations of the Association for Electrical, Electronic and Information Technologies (Verband der Elektrotechnik Elektronik Informationstechnik e.V.(VDE)) and also international standardisation according to ISO and IEC, unless the nuclear regulations contain more specific requirements.

9.3. REGULATIONS AND GUIDES FOR RESEARCH REACTORS

In Germany, there are different kinds of research reactors, teaching reactors, a TRIGA type reactor and a high flux reactor. These will continue operation after the phase out of nuclear power plants.

The Atomic Energy Act provides for regulations and guides on the installation and operation of reactors, which includes the criteria for the permission of establishment of the research reactors. The graded approach is stipulated in the Basic Law and the Atomic Energy Act as a proportionality manner to each nuclear facilities.

The regulatory framework does not include any specific design requirements for research reactors and there are no safety requirements for specific research reactors. The Safety Requirements for Nuclear Power Plants (2015) is applied to different kinds of research reactors with a graded approach. So applicable regulations and guides (i.e. KTAs for NPPs) are specified case-by-case with a graded approach.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>There are no specific written regulations or guides on how to apply a graded approach to design, operation, authorization, review and assessment for research reactors. This issue is identified in the advanced reference material and is part of the Action Plan.</i>	
(1)	BASIS: GSR Part 1 Requirement 32, para. 4.61 states that “ <i>The regulations and guides shall be kept consistent and comprehensive, and shall provide adequate coverage commensurate with the radiation risks associated with the facilities and activities, in accordance with a graded approach.</i> ”
(2)	BASIS: SSR-3 Requirement 12 states that “ <i>The use of the graded approach in application of the safety requirements for a research reactor shall be commensurate with the potential hazard of the facility and shall be based on safety analysis and regulatory requirements.</i> ”
(3)	BASIS: SSG-22 para. 2.7 states that “ <i>The individual characteristics, or attributes, to be considered in deriving the category of the facility in accordance with its hazard are typically as follows:</i>

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	<p><i>(a)The reactor power (for pulsed reactors, energy deposition is typically used, while for accelerator driven subcritical systems, thermal power is typically used);</i></p> <p><i>(b)The radiological source term;</i></p> <p><i>(c)The amount and enrichment of fissile material and fissionable material; ...”</i></p>
S18	<p>Suggestion: The regulatory authority should consider specifying the aspects in the regulations and/or guides on how to apply a graded approach to design, operation, authorization, review and assessments for research reactors.</p>

9.4. REGULATIONS AND GUIDES FOR FUEL CYCLE FACILITIES

The Atomic Energy Act establishes the basic framework policy for ensuring the safe use of nuclear fuel cycle facilities, and the subordinate legislation sets out the detailed regulatory framework. The Atomic Energy Act and the Nuclear Safety Officer and Reporting Ordinance refer to “nuclear installations”, so that regulatory texts are applicable both to nuclear power plants and to research reactors and any nuclear fuel cycle facilities.

The framework contains a significant amount of documentation that defines the regulatory requirements and expectations for fuel cycle facilities, with specific reference to the Safety Requirements for Fuel Cycle Facilities from BMU. Furthermore, many KTA safety standards apply to fuel cycle facilities, such as, for instance, KTA Regulations 1201 “Requirements for the Operating Manual”, KTA 1402 for the Integrated Management Manual.

These ordinances and guides cover each stage of the facility’s lifecycle and define the content of the submissions that the licensee has to provide in its application to the regulatory body when seeking authorisation to undertake an activity.

It is the responsibility of the licensee to identify the codes and standards that are applicable to the structures, systems and components for the fuel cycle facilities, and to demonstrate that they are suitable for each application and develop the associated application.

9.5. REGULATIONS AND GUIDES FOR WASTE MANAGEMENT FACILITIES

Spent Fuel storage

In the area of spent fuel management, the recommendations of the German Commission on Radiological Protection (SSK) and the Nuclear Waste Management Commission (ESK) play an important role in licensing and supervisory procedures. These independent expert committees advise the BMU on radiation protection and nuclear waste management issues. The SSK and ESK present their results to the Ministry in the form of statements or recommendations, which are prepared in committees and working groups. Through publication in the Federal Gazette, these recommendations are included in the nuclear regulations and, in individual cases, recommended for use by BMU circulars. Within its area of responsibility (in particular, licensing according to § 6 of the Atomic Energy Act), the Federal Office for the Safety of Waste Management (BfE) evaluates the recommendations and statements of the ESK within the licensing procedure, in particular for any installations-specific relevance. It decides whether and, if so, which action needs to be taken in each specific case and initiates action, if necessary.

The ESK and SSK recommendations only become legally binding by being taken into account in the nuclear licences or the decrees issued by the BfE and the supervisory authorities.

As referenced in section 5.5, licensees of spent fuel storage will need to make applications for extended storage and, at the moment, no regulatory guides addresses the issue of extended storage. The BMU proposes to develop guidance on the safety issues related to extended storage.

Waste Management Facilities

Germany has defined two types of radioactive waste – heat-generating radioactive waste and radioactive waste with negligible heat generation. There is currently no disposal facility available for either waste category but the strategy for both categories is disposal in deep geological formations.

There is no site currently identified for the disposal of heat generating waste. The Site Selection Act sets out the legal framework and process for selection of a site. This enables the issue of statutory ordinances on the introduction of safety requirements and guidance for the conduct of preliminary safety analyses for a disposal site. These ordinances are currently being drafted with a view to issue in 2019 or 2020. “Safety requirements for the disposal of heat generating waste”, published in 2010, provide a basis for development of the ordinances, and supersede the document “Safety criteria for the Final Disposal of Radioactive Waste in a Mine” published in 1983.

The application of a graded approach to the “Safety requirements for the disposal of heat generating waste” is being considered for safety requirements for the planned closure of the Morsleben disposal facility for radioactive waste with negligible heat generation.

The former mine at Konrad will be the disposal facility for radioactive waste with negligible heat generation and is expected to become operational in 2027. The plan approval issued in 2002 contains requirements for the long-term and operational safety of the facility and was permissioned on the basis of the “Safety criteria for the Final Disposal of Radioactive Waste in a Mine”, amongst other regulatory requirements.

There are no specific safety requirement documents for disposal of radioactive waste with negligible heat generation other than the Safety criteria for the Final Disposal of Radioactive Waste in a Mine published in 1983. There is a legal requirement that necessary precautions have to be taken in the light of the latest science and technology to prevent damage resulting from the erection and operation of a facility. There is an ongoing review of the safety analysis for Konrad to determine whether any changes to the approved plan are necessary and whether issue of a new licence may be warranted.

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Observation: *There are no specific safety requirements/guidance documents for the disposal of radioactive waste with negligible heat generation, other than requirements specified in the plan approval for the planned disposal facility. Current standards are applied by the regulatory body during oversight of compliance with the plan approval.*

(1)

BASIS: SSR 5 Part 5 Requirement 2 states that *“The regulatory body shall establish regulatory requirements for the development of different types of disposal facility for radioactive waste and shall set out the procedures for meeting the requirements for the various stages of the licensing process. It shall also set conditions for the development, operation and closure of each individual disposal facility and shall carry out such activities as are necessary to ensure that the conditions are met.”*

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S19	Suggestion: The regulatory body should consider the revision of safety requirements/guidance documents for the development, operation and closure of disposal facilities for radioactive waste with negligible heat generation, taking account of the state of the art in science and technology.
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The volume of decommissioning waste will increase as a result of the closure and dismantling of all remaining NPPs by the end of 2022. Radioactive waste will continue to arise from other facilities. The expected storage durations for radioactive waste with negligible heat generation (20 years) may need to be extended because disposal may take longer than anticipated.

Radioactive waste with negligible heat generation are being conditioned to meet the waste acceptance criteria for the Konrad disposal facility and then placed in interim storage. Relatively small volumes are not expected to meet these criteria and may need to be disposed of in the planned disposal facility for heat generating waste.

There is extensive guidance on the management of radioactive waste and radioactive residues. Authoritative advisory bodies such as ESK provide recommendations to the regulatory body and the government on radioactive waste management, which are incorporated into sub-statutory regulations to become binding, for example by means of incorporation into licences. The Action Plan in the ARM states “the Federation and the Länder, determine the necessary demand for a redevelopment and advancement of the sub-statutory regulations. This should be/is guided by the needs after 2022 in particular for research reactors, decommissioning and dismantling, and storage and disposal”. The IRRS Review Team agrees with this need and considers that it should better reflect the interdependences of the various steps.

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Observation: *In the light of the transition of all remaining operational NPPs into decommissioning in 2022, the existing guidance and regulations for predisposal management of all radioactive waste do not adequately reflect the interdependences of the various steps of predisposal management, and the possibility of extended storage periods.*

(1)	BASIS: GSR Part 5 Requirement 6 states that “Interdependences among all steps in the predisposal management of radioactive waste, as well as the impact of the anticipated disposal option, shall be appropriately taken into account.”
(2)	BASIS: GSR Part 5 Requirement 11 states that “Waste shall be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management. Due account should be taken if the expected period of storage, and, to the extent possible, passive safety features shall be applied. For long term storage in particular, measures shall be taken to prevent degradation of the waste containment.”
(3)	BASIS: GSR Part 6 Requirement 14 states that “Radioactive waste shall be managed for all waste streams in decommissioning.”

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Suggestion: The regulatory body should consider updating the guidance on the predisposal of radioactive waste to ensure they reflect the interdependences between the steps of predisposal management and the possibility of extended storage periods.

9.6. REGULATIONS AND GUIDES FOR DECOMMISSIONING ACTIVITIES

The decommissioning of an installation in accordance with § 7 para 1 Atomic Energy Act, the safe enclosure of the finally decommissioned installation and the dismantling of the installation or parts of installations require a license according to § 7 (3) Atomic Energy Act. The licensing requirements set out in § 7 (2) Atomic Energy Act apply accordingly. Insofar as operators are paying parties according to sentence 1 of § 2 (1) of the Disposal Fund Act, their installations have to be decommissioned and dismantled immediately.

The prime responsibility for safe decommissioning rests with the operator who shall develop the required safety documentation to support authorisation. Decommissioning applications are prepared by the operators for each NPP unit facing decommissioning.

Two guides address decommissioning;

- Decommissioning Guide 2016 (Guidance to the decommissioning, the safe enclosure and the dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act) and;
- ESK Decommissioning Guide

Section 3.5 of the Decommissioning Guide 2016 indicates that “if there are other nuclear facilities at the site, the possible impacts on the other nuclear facilities are to be shown for dismantling measures and it must be demonstrated that there is no reason to suspect any inadmissible impacts on them”. This statement addresses the safety demonstration during decommissioning.

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Observation: *The Decommissioning Guide (2016) does not address interdependences among multiple facilities and authorised parties at the same site which may affect the implementation of the dismantling project and the sequence and planning of dismantling phases.*

(1)

BASIS: GSR Part 6 Requirement 8 para. 5.1 states that “The preferred decommissioning strategy shall be immediate dismantling. However, there may be situations in which immediate dismantling is not a practicable strategy when all relevant factors are considered.”

(2)

BASIS: GSR Part 6 Requirement 8 states that “The licensee shall select a decommissioning strategy that will form the basis for the planning for decommissioning. The strategy shall be consistent with the national policy on the management of radioactive waste.”

(3)

BASIS: GSR Part 6 Requirement 8, para. 5.5 states that “For sites with more than one facility, a site strategy for decommissioning shall be developed to ensure that

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	<i>interdependences between the facilities are taken into account in the planning for individual facilities that will lead to final decommissioning plans for each facility (e.g. by means of release of parts of the site from regulatory control, if justified)."</i>
S21	Suggestion: The regulatory body should consider revising decommissioning guidance to address interdependences among multiple facilities and authorised parties at the same site when implementing dismantling projects.

As far as licensing is concerned, facilities in Germany are regulated either under the Atomic Energy Act (AtG) or either under the Radiation Protection Act. The Decommissioning Guide (2016) addresses facilities regulated under the Atomic Energy Act §7. There is no guidance on decommissioning for facilities regulated under the Radiation Protection Act. These are mainly storage facilities of radioactive waste with negligible heat generation and land collecting facilities.

There are no facilities regulated under the Radiation Protection Act which are currently under decommissioning. In addition, depending on the situation at sites, similar storage facilities are regulated either under the Atomic Energy Act or either under the Radiation Protection Act.

The IRRS team found that the Decommissioning Guide is applied for facilities regulated under the Radiation Protection Act which undertake decommissioning actions using a graded approach.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>There is no guidance on decommissioning for facilities regulated under the Radiation Protection Act.</i>	
(1)	BASIS: GSR Part 6 Requirement 5 states that <i>"The regulatory body shall regulate all aspects of decommissioning throughout all stages of the facility's lifetime, from initial planning for decommissioning during the siting and design of the facility, to the completion of decommissioning actions and the termination of authorization for decommissioning."</i>
S22	Suggestion: The regulatory body should consider developing guidance on decommissioning for facilities which are regulated under the Radiation Protection Act.

In the context of the German phase out of nuclear power, the legal and regulatory framework will have to be reviewed and updated to face the challenges of the decommissioning. Two issues have to be addressed:

- To identify which legal and regulatory requirements will no longer be needed after 2022
- To identify which legal and regulatory requirements are applicable to decommissioning to facilitate implementation of decommissioning projects for NPPs which are already shutdown

The Decommissioning Guide (§7 of AtG) issued in 2016 addresses these issues in detail in annexes 2 and 3. Annex 2 identifies around 180 regulatory documents (issued from the 1980's) and categorises them. Category 1 documents are not applicable to decommissioning, Category 2 documents are applicable to decommissioning. Category 3 documents are generally applicable after adaptation. Annex 3 indicates for all Category 3 documents how the requirements should be addressed.

This work has been implemented using a graded approach and provides the basis for review and updating the German legal and regulatory framework in the future. This work is the only example of such anticipation of the change to decommissioning observed until now. The Action Plan addresses this issue in the action 9.1 regarding “*the necessary demand for a redevelopment and advancement of the sub-statutory regulations*”. This work is considered as an area of good performance.

It has been indicated to the IRRS team that a new review of the Decommissioning Guide 2016 is currently under progress.

9.7. REGULATIONS AND GUIDES FOR OCCUPATIONAL EXPOSURE

The regulations on occupational exposure are mainly set in the Radiation Protection Act (RP Act) and the Radiation Protection Ordinance. These regulations entered into force in December 2018.

The RP Act contains the provisions for the protection of man and the environment from the harmful effects of ionizing radiation in planned, emergency and existing exposure situations. In this Act, the responsibilities of the Federal Authority and Länder authorities are set, as well as the various responsibilities of employers, registrants and licensees with respect to occupational exposure. The Radiation Protection Ordinance provides the modalities to fulfil these responsibilities.

Justification of practices includes the consideration of occupational exposure. The regulations stress that any anyone who plans or performs a practice or has a practice performed, shall avoid any unnecessary exposure and keep exposures and contaminations as low as possible, even below the limit values. Relevant dose limits are set for occupationally exposed persons, with stricter limit values for occupationally exposed persons under 18 and for women at childbearing age. A limit value for occupational lifetime dose has been set as well.

Provisions on radiation protection programmes, assessment of occupational exposure, health surveillance, information, instruction and training of workers and for recording of all these aspects are set. With the new legislation dose constraints are introduced as an additional mean for the optimization of occupational exposure.

Offering benefits as substitutes for measures for protection and safety would conflict with the requirements on optimization, which would imply an infraction, and is therefore not allowed.

Occupational exposure in existing and emergency exposure situations is also dealt with in these regulations.

The establishment and management of the national dose register and the use of a radiation passbook for itinerant workers is covered by the Radiation Protection Act.

Itinerant workers are issued with a radiation passbook, which allows them to have a view on their exposure records. Furthermore, air crew gets a least yearly an information about their occupational exposure (§ 64 (3) Sentence 2 of the Radiation Protection Ordinance). Workers that are employed by a licensee do not have a radiation passbook and receive their exposure records only upon request workers to the radiation protection executive (§64 (3) of the Radiation Protection Ordinance) or upon request to the national dose register (§170 (6) of the Radiation Protection Act). They should receive their exposure records in a more proactive way in order to increase their involvement and awareness, and support safety culture and optimization.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *Workers that are employed by a licensee do not have a radiation passbook and receive their exposure records only upon request to the radiation protection executive (§64 (3) of the Radiation Protection Ordinance) or upon request to the national dose register (§170 (6) of the Radiation Protection Act).*

(1)	<p>BASIS: GSR Part 3 Requirement 25, para. 3.106 states that “Employers, registrants and licensees:</p> <p>(a) Shall provide workers with access to records of their own occupational exposure;”</p>
S23	<p>Suggestion: The regulatory body should consider establishing regulatory requirements to mandate provision of relevant exposure records to workers employed by a licensee, not only upon request.</p>

9.8. SUMMARY

The IRRS team found that regulations and guides for NPPs are comprehensive and reviewed regularly to ensure they are updated with changes in science and technology, and changes in international best practice. The IRRS team found some areas for improvement related to using a graded approach to guides used for the supervision of research reactors, the need to revise requirements and guidance for radioactive waste with negligible heat generation. There is also the need to revise guidance on decommissioning to address interdependences with other facilities when implementing dismantling projects and for facilities regulated under the Radiation Protection Act. Regulatory requirements should be considered for providing exposure records to workers working for licensees.

10. EMERGENCY PREPAREDNESS AND RESPONSE REGULATORY ASPECTS

The Federal government in Germany has the legislative power for protection against dangers arising from use of nuclear energy or from ionizing radiation, including EPR. The execution of the federal laws regarding nuclear safety and radiation protection as part of the EPR in Germany is the responsibility of the Länder on behalf of the federation. Immediate emergency response in connection with civil protection is the sole responsibility of the Länder. The operator or the license holder is responsible for on-site EPR.

The BMU is the competent supreme federal authority and National Competent Authority (NCA) in an international context within EPR. To this end, BMU is supported by the subordinate federal offices, BfS and BfE as well as by the TSO GRS. At Land level, the supreme Land authorities designated by the Land governments are responsible for EPR in nuclear licensing and supervision as well as for civil protection.

10.1. AUTHORITY AND RESPONSIBILITIES FOR REGULATING ON-SITE EPR OF OPERATING ORGANIZATIONS

Authority and responsibility to regulate EPR of operating organizations

On-site EPR for nuclear installations and practices is regulated by the Atomic Energy Act and Radiation Protection Act. The Radiation Protection Act also regulates on-site EPR for other installations and practices. The Länder assign administrative responsibilities regarding on-site EPR for the execution of the Federal laws in Land specific regulations. As an exception, licensing of on-site EPR for interim and future final storage of spent fuel is executed on a federal level.

Requirements with respect to on-site EPR are defined at statutory and ordinance level as well as in expert recommendations and guidelines. The licensing authority verifies the compliance of the operator's on-site EPR measures with the provisions during the licensing process. The supervisory authority verifies the compliance of the operator's on-site measures on a regular basis through the entire lifetime of the installation. If, during operation, on-site EPR does not comply with the requirements, the supervisory authority can enforce corrections or, as a last resort, withdraw the licence temporarily or permanently. The licensee is also obliged to continuously improve nuclear safety, including on-site EPR. In this respect the operator is obliged to regularly perform exercises and update and improve on-site EPR based on lessons learned from the exercises.

Coordination of organizations with responsibilities in regulating EPR of operating organizations

Coordination of organizations involved in regulating EPR of operating organizations is achieved through permanent committees and expert groups. In particular, the Federal and Länder Committee for Nuclear Energy (LAA) is a permanent body for coordination between the federation and the Länder. Independent expert groups are also used by BMU to address scientific, technical or organizational aspects of nuclear safety and radiation protection. These groups regularly include experts from Länder authorities, operators, universities and federal support organizations.

Resources and organizational structure of the RB to regulate EPR of operating organization

At federal level, the division for nuclear safety at BMU has the main task of preparing regulations for EPR. This work is supported by subordinate offices (BfS and BfE) and by other support organizations. At Länder level, the licensing and supervisory authorities are responsible for verification, assessment and enforcement for on-site EPR. The Länder authorities regularly consult external experts for support to this end.

Graded approach in regulating EPR of operating organizations

The licensing and supervisory authorities of the Länder apply a graded approach in regulating on-site EPR. The graded approach takes account of the different types of installations and phases of operation. The requirements for the operator's on-site EPR provisions are derived from requirements developed for NPPs in power operation but are adopted on basis of an individual hazard assessment for other installations. The authorities' supervisory activity with regards to on-site EPR also depends on the operation state, i.e. normal operation, incident or accident.

Protection of emergency workers

Protection of emergency workers is well regulated in the Radiation Protection Act and Radiation protection Ordinance. Responsibilities are clearly delineated, with reference levels and requirements on instruction, training and further qualification of emergency workers. Education and training is addressed in documents specific to the type of emergency workers. Doses of emergency workers are assessed and recorded in the national dose register.

10.2. REGULATIONS AND GUIDES ON ON-SITE EPR OF OPERATING ORGANIZATIONS

Regulation of on-site EPR for operating organizations

On-site EPR in Germany is regulated at statutory level, at ordinance level and by various guidelines and expert recommendations. The Atomic Energy Act regulates licensing and supervision of nuclear installations, and the licensing of transport and storage of nuclear fuels, and regulates the operator's responsibilities with respect to nuclear safety. The Nuclear Licensing Ordinance specifies the documentation for on-site EPR to be provided by the operator during the licensing process. The Nuclear Safety Officer Reporting Ordinance regulates the operators' responsibilities with respect to alerting the authorities in case of emergencies, accidents, incidents or other relevant events.

The Radiation Protection Act regulates a wide field of practices and provides the legal basis to stipulate ordinances relating to monitoring of releases, planning of protective measures for mitigation and responsibilities of the operator with respect to incidents and emergencies. The Radiation Protection Ordinance further specifies the requirements with respect to on site EPR, including implementation and maintenance of adequate preventive EPR measures, coordination with authorities involved in off-site EPR including support and advice, information for the public on measures to be taken in case of an emergency and the obligation of the operator to take immediate actions in an emergency. The Guideline for Emission and Emission Monitoring (REI) further specifies the requirements for the operator on monitoring of emissions and emissions which also apply during an incident or emergency.

Guides on on-site EPR for operating organizations

The generic regulations are specified in expert recommendations and guidelines to be taken into account by the licensing and supervisory authorities during the licensing of installations. The Safety Requirements for nuclear power plants (BMU) specifies the necessary precautions against damage through the construction and operation of the NPP, define the concept of defence in depth and on-site measures and support to off-site emergency response to be prepared for different safety levels.

Regarding on-site EPR, the Safety requirements for nuclear power plants (BMU) specifies emergency scenarios and conditions to be considered in the planning process. The Requirements for the Emergency Manual (KTA) specifies the contents of the emergency manual and the transition from the operating manual to the emergency manual. The Framework recommendations for planning emergency response measures by licensees of nuclear power plants (SSK, RSK) specifies general requirements for on-site EPR planning.

These requirements can be transferred to other nuclear facilities to the extent that on-site EPR planning is required.

The Criteria for notifying the civil protection authorities of alarms by operators of facilities (SSK, RSK) specifies an alarm concept based on two alarm levels, a pre-alarm and a disaster alarm. These alarm levels are generally equivalent to site area emergency and general emergency as defined by IAEA. In addition, the Safety requirements for fuel cycle facilities (BMU) specifies requirements for on-site EPR for uranium enrichment plants and fabrication of fuel assemblies for light water reactors. For storage of radioactive material, requirements for on-site EPR are provided in the Guidelines for dry cask storage of spent fuel and heat generating waste (ESK) and the Guidelines for the storage of radioactive waste with negligible heat generation (ESK).

Authority and responsibility assigned to the operating organization to take actions on-site

The operator is obliged to take immediate measures to avert dangers for human health according to requirements in the Radiation Protection Act. In case of an emergency or incident the operator is also obliged to take all measures necessary in order to mitigate the consequences of the emergency or incident according to requirements in the Radiation Protection Ordinance. Further requirements on the operator to take immediate measures and to mitigate consequences under these conditions are provided in the Basic recommendations for the planning of emergency protection measures by nuclear power plant operators (SSK), the Requirements for the Emergency Manual (KTA) and the Safety requirements for nuclear power plants (BMU).

Mechanisms for review and revision of emergency arrangements

According to the Atomic Energy Act, the operator is obliged to revise the on-site EPR arrangements according to the state of the art of science and technology and to review and revise, as appropriate, the on-site EPR arrangements prior to relevant changes to the facility. This is considered in the licensing procedure prior to the changes. The Basic recommendations for the planning of emergency protection measures by nuclear power plant operators (SSK, RSK) further specifies that emergency plans shall be regularly reviewed and updated by the licensee, taking into account lessons learned from exercises and real events. The facilities and equipment to be used during emergencies or incidents shall also be inspected periodically for functionality, completeness and for being up to date.

10.3. VERIFYING THE ADEQUACY OF ON-SITE EPR OF OPERATING ORGANIZATIONS

Verification of the adequacy of on-site EPR prior to commencement of operation and throughout the lifetime of the installation

According to the Atomic Energy Act, the licensing and supervisory authorities review on-site EPR as part of the licensing procedure before the commencement of operations of a nuclear facility. After issuing of a license, the licensee is obliged to adhere to the requirements for on-site EPR stipulated in the license and ensure through regular testing and exercises that on-site EPR is functional and operational. The operator is also obliged to adapt on-site EPR to new requirements and findings made internally, nationally and internationally and to improve the existing on-site EPR accordingly.

Following requirements in the Atomic Energy Act and the Radiation Protection Ordinance, the licensing and supervisory authorities has to check and approve the operator's emergency manual during licensing and continuously during operations. Detailed requirements for the emergency manual are given in the Requirements for the Emergency Manual (KTA).

The supervisory authorities generally carry out inspections of facilities following an internal plan, the annual inspection program and after events. Preparation for an on-site inspection takes account of the

requirements for emergency precautions, operational experiences, operator planning, and documentation. The requirements are verified and classified according to conformance to the required conditions.

The Atomic Energy Act and the General guidelines for emergency planning by nuclear power plant operators require regular exercises to take place in which the supervisory authorities and the experts commissioned by them under the Atomic Energy Act can participate as observers on-site. Internal exercises for on-site EPR including the interfaces to disaster control also take place. In the Framework recommendations for planning emergency response measures by licensees of nuclear power plants (SSK, RSK), it is further specified that internal exercises shall be conducted at least once a year and that external exercises with the participation of authorities and support organizations shall be conducted at least every 5 years. In addition, the supervisory authorities in the Länder also initiate unannounced emergency exercises.

The nuclear licensing and supervisory authorities have unlimited access to all operator exercises and the documents compiled in conjunction with them. Exercise reports concerning the process of internal exercises and important findings are incorporated into emergency planning. In training measures, participants receive feedback. The documents on EPR are checked regularly for completeness and correctness.

Authority of the RB to enforce and follow-up corrective actions in relation to on-site EPR of operating organizations

The requirements on EPR arrangements are verified and classified in inspections. Depending on the case, this classification can include notes for corrective actions or can lead to an immediate shut-down of the facility.

Coordination with off-site response organizations

For facilities with high hazard potential, special off-site emergency response plans are compiled by the competent civil protection authorities of the Länder with the participation of the operator and taking account of on-site emergency provisions. The legal basis for this is set out in the Radiation Protection Act and in the disaster control laws of the Länder. The stipulations for these special disaster control plans to be implemented by the Länder have been standardized in the General Guidelines for emergency response in the vicinity of nuclear installations (SSK). These off-site emergency response plans focus on the interaction of planning by the authorities and the licensee, in addition to implementation of measures for the protection of the public.

10.4. ROLES OF THE RB IN A NUCLEAR OR RADIOLOGICAL EMERGENCY

Roles of the RB in response to a radiological or nuclear emergency

The off-site EPR system in Germany is characterized by the federal structure of the state leading to shared responsibilities between Federation and Länder. The new Radiation Protection Act introduces significant changes and innovations to off-site EPR in order to comply with Council Directive 2013/59/Euratom. The implementation of the new legal requirements is still ongoing.

The requirements for off-site emergency preparedness are primarily targeted to severe nuclear power plant accidents and are graded accordingly for installations where the potential consequences of an emergency are lower. According to the Radiation Protection Act, it is the responsibility of the competent Land authorities to determine the scope of the necessary off-site emergency planning for all installations based on an individual hazard assessment. The federal and Länder authorities also have the responsibility to inform the population about risks as well as protective actions and behavioural recommendations in case of possible radiological or nuclear emergencies.

The Radiation Protection Act requires the preparation of coordinated emergency response plans of the Federation and the Länder with clearly allocated responsibilities during the emergency response. These

emergency response plans are currently being prepared. Provisional emergency plans are in force during this preparation phase. The new general federal emergency response plan to be established by BMU will contain ten reference scenarios and optimized protection strategies for each reference scenario to be considered in all emergency plans at the federal and Land level. The regulatory body should consider that there is an item in the Action Plan in the ARM to develop general and special emergency plans based on the reference scenarios defined according to the Radiation Protection Act, to replace the existing provisional plans. This has been noted as a suggestion.

In addition, special federal emergency response plans are being prepared which describe the emergency response in the affected legal areas and in administrative areas outside radiation protection. In principle, the authorities performing emergency response tasks in everyday business in the implementation of federal laws also retain this responsibility and competence in the case of radiological or nuclear emergencies, in the so-called sector-interlinking approach.

General and specific emergency response plans are also implemented by the Länder. In addition, the civil protection authorities prepare off-site emergency response plans for nuclear installations with a high-risk potential. These plant-specific off-site emergency response plans also define the interfaces between on-site and off-site emergency response in terms of interaction of the operator with the authorities.

The comprehensive requirements on the Federal Government and the Länder to establish and coordinate general and special emergency plans, as well as requirements on the authorities responsible for disaster control or public safety to establish external emergency plans based on the same reference, form a robust basis for well-coordinated emergency preparedness at all levels of the state and by all authorities with responsibilities to take action in a radiological or nuclear emergency. This is noted as an area of good performance.

Protection goals and early protective actions

For emergency exposure situations, a general reference value of 100 mSv applies to the effective dose of the population within the first year following the onset of the emergency as stipulated by the Radiation Protection Act. This reference value can be lowered by fast-track legislation depending on the situation, but even below the reference value, the dose burden should be kept as low as possible by means of suitable protection actions. Dose levels that serve as radiological criteria for the adequacy of the early protective actions of evacuation, sheltering and iodine thyroid blocking (ITB) are established in a federal ordinance. In addition, directly measurable and applicable dose rates or contamination values (Operational Intervention Levels, OILs) for e.g. foodstuffs and feedstuffs may be established beforehand or by fast-track legislation in an emergency. The dose criteria and OILs are consistent with the general reference value.

Based on the lessons learned from the nuclear accident at Fukushima Daichi, the emergency planning zones for early protection actions in the vicinity of NPPs have been extended. Evacuation plans are prepared within a radius of about 20 km around a nuclear power plant. Iodine tablets are stored for all persons for whom iodine blocking is to be provided (adults up to the age of 45 years) within a radius up to 100 km around an NPP. Iodine tablets for pregnant women, children and adolescents up to 18 years are stored within the entire federal territory. Sheltering is planned within a radius of about 100 km around a nuclear power plant. For installations where the potential consequences of an emergency are lower, these planning specifications may be graded or declared unnecessary with the approval of the licensing authority.

Capability of the RB to fulfil its role in emergency response

The BMU has established a federal Radiological Situation Centre (RLZ) as a merger of the key players at a federal level during an emergency, BMU, BfS and GRS. The BMU provides the head office of the RLZ and is supported by BfS for assessment of the off-site situation and by GRS for assessment of the on-site situation. The RLZ receives further support from the crisis team of the SSK as well as from numerous

federal scientific and technical institutions. The RLZ is tasked with recording, assessing and presenting the radiological situation. RLZ also has responsibilities for informing the public and the preparation and coordination of protective actions. Unless otherwise specified, the RLZ furthermore coordinates the emergency response within the Federation and with the Länder as well as internationally, as long as no other responsibility has been specified.

For supra-regional and regional emergencies, the evaluation of the radiological situation by all federal and Länder authorities is always based on a unique radiological situation report. Emergencies related to events in NPPs are generally classified as supra-regional, and the same applies to emergencies in foreign plants. The general federal emergency plan will provide a classification as a supra-regional, regional or local emergency, for each given reference scenario. In the case of supra-regional emergencies, the RLZ draws up the radiological situation report and distributes it to the Länder and all competent federal authorities. The Länder provide any relevant information at their disposal, including the supervisory recording and assessment of the condition of the installation and its further development to the RLZ. For regional emergencies, the Land in which the emergency has occurred is responsible for providing the radiological situation report. However, in general or on a case-by-case basis, the Land may delegate this task to the RLZ in agreement with the BMU. RLZ may also assume this task in individual cases on its own authority.

RLZ provides the radiological assessment as a basis for decisions on protective actions to the Länder especially their authorities responsible for disaster control and – following the sector-interlinking approach – to all supreme federal authorities having responsibilities to take, to coordinate or to support response actions in their affected legal and/or administrative areas. The relevant information needed to respond to a radiological or nuclear emergency is brought together in the Integrated Measurement and Information System (IMIS). IMIS is always in operation as it is used routinely to store and display environmental monitoring data.

Depending on the significance of the event, crisis management teams will be set up at the competent Länder authorities. The criteria for convening these staff units and the tasks and responsibilities are individually regulated for each Land in the civil protection laws and plans. The nuclear licensing and supervisory authority has the task of providing technical advice to the crisis management teams if a nuclear accident occurs. Even in the case of emergencies with supra-regional effects in which the RLZ is responsible for providing the radiological situation report, the tasks of the specialist advisory staff of the nuclear licensing and supervisory authorities of the affected Länder remain, insofar as all available information about the situation and situation reports has to be transmitted to the RLZ for further use. The advisory mandate of the nuclear licensing and supervisory authority within the civil protection organization of the respective Land authority continues to apply.

The Federal Government and the Länder as and the authorities responsible for disaster control or public safety have access to the information at all times via the IMIS system. In particular, it contains in cases of regional or supra-regional emergencies a unique Radiological Situation Report to be used by all organizations responsible for taking actions in an emergency. This forms a solid basis for a coordinated response in a radiological or nuclear emergency. The IMIS system and the unique radiological situation report is noted as a Good Practice.

The authorities and organizations involved in emergency response are obliged to carry out emergency exercises on a regular basis. This obligation also applies to those bodies responsible for the training and further qualification of emergency services staff. The exercises take place with changing participants. Depending on the scenario, this includes not only the operator, but also the authorities responsible for emergencies and aid organizations as well as foreign authorities and institutions in cross-border scenarios.

To respond to a severe nuclear emergency both equipment and trained professionals are needed. Some of these resources are provided by nuclear support organizations that are partly funded by the NPPs. These support organizations will no longer be funded to the same extent when all NPPs are decommissioned. Even if all resources and equipment provided by these support organizations are no longer required, some of the resources could be needed to respond to emergencies at foreign nuclear power plants affecting Germany or emergencies at other nuclear facilities in Germany. An evaluation to this end is noted as a suggestion.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>Provisional general and special emergency plans have been issued, but they are not yet based on the reference scenarios defined according to the Radiation Protection Act. This has been recognized in the ARM and is part of the Action Plan.</i>	
(1)	BASIS: GSR Part 7 para. 6.17 states that “Each response organization shall prepare an emergency plan or plans for coordinating and performing their assigned functions as specified in Section 5 and in accordance with the hazard assessment and the protection strategy. An emergency plan shall be developed at the national level that integrates all relevant plans for emergency response in a coordinated manner and consistently with an all-hazards approach. Emergency plans shall specify how responsibilities for managing operations in an emergency response are to be discharged on the site, off the site and across national borders, as appropriate. The emergency plans shall be coordinated with other plans and procedures that may be implemented in a nuclear or radiological emergency, to ensure that the simultaneous implementation of the plans would not reduce their effectiveness or cause conflicts.
S24	Suggestion: The regulatory body should consider developing general and special emergency plans based on the reference scenarios defined according to the Radiation Protection Act (to replace the existing provisional plans).

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: <i>The extent of resources needed after the phase out to prepare for and respond to emergencies at foreign nuclear power plants affecting Germany or emergencies at other nuclear facilities in Germany and the means of funding those resources have not been fully evaluated.</i>	
(1)	BASIS: GSR Part 7 para. 4.8 states that “The government shall ensure that response organizations, operating organizations and the regulatory body have the necessary human, financial and other resources, in view of their expected roles and responsibilities and the assessed hazards, to prepare for and to deal with both radiological and non-radiological consequences of a nuclear or radiological emergency, whether the emergency occurs within or beyond national borders.”
S25	Suggestion: BMU should consider evaluating the extent of resources needed to prepare for and respond to emergencies at foreign nuclear power plants affecting

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Germany or emergencies at other nuclear facilities in Germany and, if necessary, secure funding of those resources after the phase out.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Observation: *The relevant information for response to a radiological or nuclear emergency is collected in the Integrated Measurement and Information System (IMIS). The Federal Government and the Länder as well as the authorities responsible for disaster control or public safety have access to the information at all times via this system. In particular, the information includes a unique Radiological Situation Report to be used by all organizations responsible to take actions in an emergency. This forms a robust basis for a coordinated emergency response.*

(1)

BASIS: *GSR Part 7 para. 6.13 states that “When several different organizations of the State or of other States are expected to have or to develop tools, procedures or criteria for use in the response to an emergency, arrangements for coordination shall be put in place to improve the consistency of the assessments of the situation, including assessments of contamination, doses and radiation induced health effects and any other relevant assessments made in a nuclear or radiological emergency, so as not to give rise to confusion.”*

GP1

Good Practice: *The Integrated Measurement and Information System (IMIS) in combination with the unique Radiological Situation Report form a robust basis for a coordinated emergency response.*

10.5. SUMMARY

The regulatory framework for on-site EPR is consistent with the IAEA Safety Standards. The regulatory framework for off-site EPR has undergone significant changes with the introduction of the new Radiation Protection Act and the established framework is in line with the IAEA Safety Standards.

Two suggestions relating to further improvement of the regulatory framework for off-site EPR has been noted: The regulatory body should consider developing general and special emergency plans based on the reference scenarios defined according to the Radiation Protection Act (to replace the existing provisional plans); BMU should consider evaluating the extent of resources needed to prepare for and respond to emergencies at foreign nuclear power plants affecting Germany or emergencies at other nuclear facilities in Germany and, if necessary, secure funding for those resources after the phase out.

One area of good performance relating to the regulatory framework for off-site EPR has been noted: The comprehensive requirements in the Radiation Protection Act on the Federal Government and the Länder to establish and coordinate general and special emergency plans and for the authorities responsible for disaster control or public safety to establish external emergency plans based on the same reference scenarios form a robust basis for effective coordination in emergency planning.

One good practice relating to the regulatory framework for off-site EPR has been noted: The Integrated Measurement and Information System (IMIS) in combination with the unique Radiological Situation Report form a robust basis for a coordinated emergency response.

IRRS GERMANY REVIEW TEAM



APPENDIX I - LIST OF PARTICIPANTS

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APPENDIX II - MISSION PROGRAMME

Time	Sat 30/3	SUN 31/3	MO 01/04	TUE 02/04	WED 03/04	THU 04/04	FRI 05/04	SAT 06/04	SUN 07/04					
9:00-10:00	Arrival of Team Members	Arrival of Team Members	Entrance Meeting	Interviews	Interviews	Interviews	Site Visits	Interviews, if needed	DTC writes introductory parts	Interviews, if needed	Report Preparation	TL and DTL review introductory part	<ul style="list-style-type: none">Discussing and improving Draft ReportCross-ReadingTL, DTL, TC and DTC read everything	Free day, Social Event
10:00-11:00														
11:00-12:00														
12:00-13:00														
13:00-14:00		Initial Team Meeting: <ul style="list-style-type: none">WelcomeMeet host liaison officerMission logisticsDiscussion of first impressionsClosing	Interviews	Interviews + In-group discussions	Departure for Site Visits	Interviews + In-group discussion	Site Visits	TM write Report	DTC writes introductory parts	Lunch		Finalisation of the Draft Report		
14:00-15:00														
15:00-16:00														
16:00-17:00														
17:00-18:00			Daily Team Meeting	Daily Team Meeting	Daily Team Meeting: Discussion of findings	Daily Team Meeting	Daily Team Meeting							
18:00-20:00								Dinner in restaurants nearby, not paid by BMU						
20:00-24:00	Informal dinner		Team Dinner	Writing of the report	Writing of the report	Daily Team Meeting: Discussion of findings	Writing of the report	TM Read Draft	Secretariat edits the report					

	MON 08/04		TUE 09/04			WED 10/04	THU 11/04	FRI 12/04			
9:00-10:00	Discussion of Recommendations, Suggestions and Good Practises with counterparts by module		Common read through and finalisation of the Report by the Team			Host reads Draft Report and Executive Summary	Plenary (Team + Host) to discuss Host comments and finalize the report	Exit Meeting Publication of Press Release			
10:00-12:00			Submission of the Draft to the Host								
12:00-13:00	Lunch		Lunch			Lunch	Lunch	Lunch			
13:00-15:00	Finalization of the report	TC, DTC prepare Executive Summary and Exit presentation	Host reads Draft Report	TL finalises Executive Summary and Exit Presentation	TC Drafts the Press Release	Written comments provided by the Host	Plenary (Team + Host) to discuss Host comments and finalize the report	Départure			
15:00-17:00									Team meeting to discuss and resolve Host comments		
17:00-18:00	Daily Team Meeting		Discussion of Executive Summary and delivery to the Host			Discussion of Executive Summary and delivery to the Host	Briefing of the Senior IAEA Manager; Finalisation of the press release and of the Preliminary Report				
18:00-20:00	Dinner in restaurants nearby, not paid by BMU		Dinner in restaurants nearby, not paid by BMU			Dinner in restaurants nearby, not paid by BMU	Farewell Dinner				
20:00-21:00	Secrétariat updates		Free			Free					
21:00-24:00	Report										

APPENDIX III – IRRS MISSION COUNTERPARTS

	IRRS Experts	Lead Counterpart	Support Staff
1.	RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT		
	JÄRVINEN Marja-Leena	Sebastian Kuhn (BMU)	Alexander Baginski (BMU)
2.	GLOBAL NUCLEAR SAFETY REGIME		
	DELFINI Ginerva	Anke Krause (BMU)	Gisela Stoppa (BMU)
3.	RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY		
	HEMSLEY Ryan FLURY Peter	Thomas Helling-Junghans (BMU)	Alexander Baginski (BMU)
4.	MANAGEMENT SYSTEM OF THE REGULATORY BODY		
	BODIS Zoltánné Elisabeth	Ursula Adenauer (BMU)	Markus Pfaff (BMU)
5.	AUTHORIZATION		
	MANSOOR Faizan	Hubertus von Raczeck (MELUND)	Philipp Genßler (MELUND)
5.-9.	NUCLEAR POWER PLANTS		
	TIPEK Zdeněk	Thomas Wildermann (UM BW)	Hubertus von Raczeck (MELUND)

	IRRS Experts	Lead Counterpart	Support Staff
5.-9.	RESEARCH REACTORS		
	MANSOOR Faizan	Ronzon Mallick (StMUV)	Hans Kühlewind (StMUV)
5.-9.	FUEL CYCLE FACILITIES		
	DIONISI Mario	Siegfried Uwe Behrendt (MWIDE)	Christian Bolle (MWIDE)
5.-9.	RADIOACTIVE WASTE MANAGEMENT FACILITIES		
	VARLEY Denise	Hilke Hattermann (NMU) Lukas Schulte (BMU)	Thomas Pissulla (BMU) Mareike Rüffer (BfE)
5.-9.	DECOMMISSIONING ACTIVITIES		
	FRANCOIS Patrice	Dietlinde Petrick (HMuKLV)	Uwe Feller (IM MV) Boris Brendebach (BMU)
5.-9.	OCCUPATIONAL EXPOSURE		
	FREMOUT An	Jörg Junkersfeld (BMU)	Andrea Bock (BMU)
6.	REVIEW AND ASSESSMENT		
	LEE Sukho	Hubertus von Raczeck (MELUND)	Dietlind Paplewski (MELUND)
7.	INSPECTION		
	TIPEK Zdeněk	Thomas Wildermann (UM BW)	Theo Spermann (UM BW)

	IRRS Experts	Lead Counterpart	Support Staff
8.	ENFORCEMENT		
	VLAHOV Nikolay	Thomas Wildermann (UM BW)	Stephan Wanke (UM BW)
9.	REGULATIONS AND GUIDES		
	NAKAJIMA Tsuyoshi	Patrick Bringel (BMU)	Anke Krause (BMU)
10.	EMERGENCY PREPAREDNESS AND RESPONSE REGULATORY ASPECTS		
	JOHANSSON Jan	Ralf Stegemann (BMU)	Tobias Schlummer (BMU)

APPENDIX IV - RECOMMENDATIONS (R), SUGGESTIONS (S) AND GOOD PRACTICES (GP)

AREA	R: Recommendation S: Suggestion GP: Good Practice	Recommendations, Suggestions or Good Practices
1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT	S1	Suggestion: BfE should consider requiring the project delivery organization (BGE) to have adequate organizational requirements including a management system to ensure high quality of site selection process, site assessment and confidence for future activities.
	S2	Suggestion: BMU should consider making clear in the regulatory framework how the Site Selection Act will be implemented in a manner that will not compromise or conflict with BfE discharging its responsibility for regulating the safety of facilities and activities.
	S3	Suggestion: BMU should consider extending the Handbook in order to cover all regulated facilities and activities and regulatory functions as well as all parts of the regulatory authority.
	S4	Suggestion: The Government should consider establishing a comprehensive plan, in consultation with relevant parties, for the project on German competence and financing needs during future decades.
2. THE GLOBAL SAFETY REGIME	S5	Suggestion: The BMU should consider increasing international participation and involvement of staff from BfE, BfS and Länder to improve the regulatory experience and feedback to Germany and to the international community.
3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY	S6	Suggestion: The Federal authorities should consider measures to ensure there is a sufficient number of qualified staff with engineering expertise.
	R1	Recommendation: BMU should include requirements for addressing public inputs during the process of termination of the decommissioning license.

4. MANAGEMENT SYSTEM OF THE REGULATORY BODY	S7	Suggestion: BMU should consider improving documentation of its safety policy by explicitly referring to applicable fundamental safety principles and approach to their implementation, leadership and management for safety, as well as commitment to continuous improvement. BfE, BfS and the Länder should consider whether similar improvements to their safety policies are needed.
	R2	Recommendation: BfE should complete the establishment and implementation of its integrated management system.
	S8	Suggestion: The Land (StMUV) should consider finalizing the handbook as a priority. The other Länder should consider developing similar documents as appropriate.
	R3	Recommendation: The regulatory body should regularly commission assessments of leadership for safety and of safety culture.
	R4	Recommendation: The regulatory body should conduct independent assessments of the management system regularly to evaluate its effectiveness and to identify opportunities for its improvement.
5. AUTHORIZATION	S9	Suggestion: The regulatory body should consider updating decommissioning guidance to identify and maintain all relevant data which must be preserved after termination of the license.
6. REVIEW AND ASSESSMENT	S10	Suggestion: The Federation and the Länder authorities should consider developing internal guidance for the review and assessment process.
	S11	Suggestion: The Federation and Länder authorities should consider developing a process for integrated safety assessment in a systematic manner for all facilities and activities.
	R5	Recommendation: The regulatory body should establish requirements for the periodic review and update of safety assessments during immediate dismantling.
7. INSPECTION	S12	Suggestion: The supervisory authorities should consider modifying internal guidance to ensure that all results of inspections are forwarded to the authorised

		party.
	S13	Suggestion: Supervisory authorities should consider completing guidance on the content of inspection reports.
	S14	Suggestion: BMU should consider developing a programmed approach to inspections for all research reactors in Germany.
	S15	Suggestion: The BMU should consider revising the regulatory framework to ensure that the supervisory authorities (Länder) provide results of inspections to the licensing authority (BfE) for dry cask spent fuel storage facilities.
8. ENFORCEMENT	S16	Suggestion: The BMU should consider measures to ensure promoting the consistency in the enforcement policies and practices at the various regulatory authorities.
9. REGULATIONS AND GUIDES	S17	Suggestion: BMU should consider updating its PSR guidance to address all safety factors with a graded approach in view of its future application for all nuclear facilities.
	S18	Suggestion: The regulatory authority should consider specifying the aspects in the regulations and/or guides on how to apply a graded approach to design, operation, authorization, review and assessments for research reactors.
	S19	Suggestion: The regulatory body should consider the revision of safety requirements/guidance documents for the development, operation and closure of disposal facilities for radioactive waste with negligible heat generation, taking account of the state of the art in science and technology.
	S20	Suggestion: The regulatory body should consider updating the guidance on the predisposal of radioactive waste to ensure they reflect the interdependences between the steps of predisposal management and the possibility of extended storage periods.
	S21	Suggestion: The regulatory body should consider revising decommissioning guidance to address interdependences among multiple facilities and authorised

		parties at the same site when implementing dismantling projects.
	S22	Suggestion: The regulatory body should consider developing guidance on decommissioning for facilities which are regulated under the Radiation Protection Act.
	S23	Suggestion: The regulatory body should consider establishing regulatory requirements to mandate provision of relevant exposure records to workers employed by a licensee, not only upon request.
10. EMERGENCY PREPAREDNESS AND RESPONSE REGULATORY ASPECTS	S24	Suggestion: The regulatory body should consider developing general and special emergency plans based on the reference scenarios defined according to the Radiation Protection Act (to replace the existing provisional plans).
	S25	Suggestion: BMU should consider evaluating the extent of resources needed to prepare for and respond to emergencies at foreign nuclear power plants affecting Germany or emergencies at other nuclear facilities in Germany and, if necessary, secure funding of those resources after the phase out.
	GP1	Good Practice: The Integrated Measurement and Information System (IMIS) in combination with the unique Radiological Situation Report form a robust basis for a coordinated emergency response.

APPENDIX V - REFERENCE MATERIAL PROVIDED BY BMU

[1] Law and convention

- Basic Law for the Federal Republic of Germany (GG) of 23rd May 1949, last Amendment of 13th July 2017, Excerpt art. 20, 30, 51, 64, 65, 73, 85, 87c
- Act on the peaceful utilisation of nuclear energy and the protection against its hazards (Atomic Energy Act) of 23rd December 1959, as amended and promulgated on 15th July 1985, last amendment of 26th July 2016
- Act on the Protection against the Harmful Effects of Ionizing Radiation (Radiation Protection Act – StrlSchG), of 27th June 2017, excerpt
- Act on the Search for and Selection of a Site for a Disposal Facility for High-Level Radioactive Waste (Site Selection Act –StandAG) of 5th May 2017, last amendment of 20th July 2017
- Act on the Convention of 26th October 1979 on the Physical Protection of Nuclear Material, of 24th April 1990, last amendment of 26th January 1998
- Act on the Establishment of a Fund for the Financing of Nuclear Waste Management (Waste Management Fund Act – EntsorgFondsG) of 27th January 2017, amended by Article 1 of the Ordinance of 16th June 2017
- Act on Transparency Regarding the Costs of Decommissioning and Dismantling of Nuclear Power Plants and the Packaging of Radioactive Waste (Transparency Act), of 27th January 2017
- Act Regulating the Transfer of Obligations for Financing and to Act for the Management of Radioactive Waste from Operators of Nuclear Power Plants (Waste Management Transfer Act) of 27th January 2017; amended by Article 4 of the Act of 5th May 2017
- Administrative Procedure Act (VwVfG) of 25th May 1976, last amendment of 18th July 2017, Excerpt §§ 20, 21, 39, 40
- Convention on Nuclear Safety, Report by the Government of the Federal Republic of Germany for the Seventh Review Meeting in March/April 2017
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Report of the Federal Republic of Germany for the Sixth Review Meeting in May 2018

[2] Ordinances

- Ordinance on the Protection against Damage and Injuries Caused by Ionizing Radiation (Radiation Protection Ordinance), 29th November 2018, excerpt
- Ordinance on the Protection against Damage and Injuries Caused by Ionizing Radiation (Radiation Protection Ordinance), 26th July 2016
- Ordinance on the Shipment of Radioactive Waste or Spent Fuel (Nuclear Waste Shipment Ordinance) of 30th April 2009, last amendment of 27th June 2017
- Ordinance Concerning the Financial Security Pursuant to the Atomic Energy Act (Nuclear Financial Security Ordinance), as of 25th January 1977, last Amendment of 27th June 2017
- Cost Ordinance under the Atomic Energy Act (AtKostV), as of 17th December 1981, last amendment of 27th June 2017
- Ordinance on the Nuclear Safety Officer and the Reporting of Incidents and other Events (Nuclear Safety Officer and Reporting Ordinance), of 14th October 1992, last Amendment of 8th June 2010
- Modification of the Nuclear Safety Officer and Reporting Ordinance, 29th November 2018
- Ordinance on the Procedure for Licensing of Installations under § 7 of the Atomic Energy Act (Nuclear Licensing Ordinance), of 18th February 1977, as Amended and Promulgated on 3rd February 1995, last amendment of 20th June 2017

- Ordinance on the verification of trustworthiness as a protection against diversion or release of radioactive material in accordance with the Atomic Energy Act (Nuclear Trustworthiness Verification Ordinance – AtZüV), of 1st July 1999, last amendment of 27th. June 2017
- Ordinance Concerning Prepayments for the Erection of Federal Facilities for the Long-Term Engineered Storage and Disposal of Radioactive Waste (Disposal Prepayment Ordinance), of 28th April 1982, last amendment of 27th June 2017
- Code of Administrative Court Procedure (VwGO) of 21st January 1960, last amendment of 8th. October 2017, Excerpt §§ 42, 43
- Ordinance on the Requirements and Methods for the Disposal of Radioactive Waste (Nuclear Waste Disposal Ordinance – AtEV), 29th November 2019
- Ordinance on the stipulation of dose values for early emergency response measures (Emergency Dose Values Ordinance - NDWV), 29th November 2019

[3] General administrative provisions

- General Administrative Provisions on the Integrated Measurement and Information System for Monitoring Radioactivity in the Environment (IMIS) in accordance with the Precautionary Radiation, Protection Act (AVV-IMIS) of 13th December 2006
- General Administrative Provision regarding § 47 Radiation Protection Ordinance: Determination of radiation exposure due to the discharge of radioactive substances from installations or facilities, only cover page and table of content
- General Administrative Provision regarding § 40 (2), § 95 (3) of the Radiation Protection Ordinance and § 35 (2) of the der X-ray Ordinance (AVV Radiation Passbook), 20th July 2004, only cover page

[4] BMU publications

- Compilation of Information Required for Review Purposes under Licensing and Supervisory Procedures for Nuclear Power Plants of 7th September 1982, Edition 10/82
- Data for the Evaluation of Site Properties for Nuclear Power Plants of 11th June 1975, Edition 7/98
- Guide to the decommissioning, the safe enclosure and the dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act as at 23rd June 2016
- Safety Review for Nuclear Power Plants pursuant to § 19a of the Atomic Energy Act - Guide Probabilistic Safety Analysis - of 30th August 2005, Edition 08/05
- Guideline concerning Emission and Immission Monitoring of Nuclear Installations of 7th December 2005, Edition 12/05
- Guideline on the Control of Residual Radioactive Material and Radioactive Waste, 19th November 2018
- Guideline Deterministic Physical Protection Analysis for the Performance of Periodic Safety Reviews (PSR) for Nuclear Power Plants in the Federal Republic of Germany – Part II – Guideline Deterministic Physical Protection Analysis
- Guideline Relating to Measures for the Protection of Facilities of the Nuclear Fuel Cycle and Other Nuclear Facilities against Disturbances or Other Interference by Individuals Entitled to Access to the Facility of 28th January 1991, Edition 3/93
- Guideline for the Maintenance of Technical Qualification of Responsible Nuclear Power Plant Personnel, Edition 08/13
- Guideline Relating to the Procedure for the Preparation and Implementation of Maintenance Work and Modifications at Nuclear Power Plants of 1st June 1978, Edition 06/78
- Guideline for the Protection of Nuclear Power Plants against Pressure Waves from Chemical Reactions by Means of the Design of Nuclear Power Plants with Regard to Strength and Induced Vibrations and by Means of the Adherence to Safety Distances of 13th September 1976, Edition 1/77

- Guideline Relating to Measures for the Protection of Facilities of the Nuclear Fuel Cycle and Other Nuclear Facilities against Disturbances or Other Interference by Individuals Entitled to Access to the Facility of 28th January 1991
- Guideline for the Technical Qualification of Radiation Protection Officers at Installations for the Fission of Nuclear Fuel, Edition 02/14
- Guideline relating to the Technical Qualification of Responsible Persons in Facilities for the Production of Fuel Elements for Nuclear Power Plants of 30th November 1995, Edition 4/97
- Guideline on Technical Qualification Required in Radiation Protection (Technical Qualification Guideline Pursuant to the Radiation Protection Ordinance) of 18th June 2004, only cover page and table of content
- Guidelines Concerning the Requirements for Safety Specifications for Nuclear Power Plants: Checklist for Format and Content of Safety Specifications for Nuclear Power Plants of 27th April 1976, Edition 6/77
- Guideline Concerning the Proof of the Technical Qualification of Nuclear Power Plant Personnel, Edition 05/12
- Guideline Relating to the Proof of the Technical Qualification of Research Reactor Personnel of 16th February 1994, Edition 3/96
- Guides for the Periodic Safety Review of Nuclear Power Plants (Basics of the Periodic Safety Review, Safety Status Analysis, Probabilistic Safety Analysis) of 18th August 1997, Edition 08/97
- Guideline for Radiation Protection of Personnel during the Execution of Maintenance Work in Nuclear Power Plants with Light Water Reactors, Part 1: The Precautionary Protective Measures to be taken during the Planning of the Plant of 10th July 1978, Edition 14/78
- Guideline concerning the Radiation Protection of the Personnel during Maintenance, Modification, Waste Management and Dismantling Work in Nuclear Facilities and Installations, Part 2: Radiation Protection Measures during the Operation and Decommissioning of a Facility or Installation (IWRS II) of 17th January 2005
- List of Contents and Structure of a Standard Safety Analysis Report for Nuclear Power Plants with Pressurized Water Reactor or Boiling Water Reactor, Edition 08/76
- Guideline on Requirements for Personal Dose Measurement Offices in Accordance with the Radiation Protection and X-Ray Ordinance of 10th December 2001
- Principles for the Applicant's/Licensee's Documentation of Technical Documents Pertaining to the Construction, Operation, and Decommissioning of Nuclear Power Plants of 19th February 1988, Edition 5/89
- Requirements for the Documentation at Nuclear Power Plants of 8th August 1982, Edition 7/85
- Requirements Relating to the Physical Protection Service and Physical Protection Officers at Nuclear Facilities and Installations of 4th July 2008, Edition 08/08
- Guideline for the determination of body doses from external and internal radiation exposure - Part 1: "Determination of the body dose in the case of external radiation exposure" (§§ 40, 41, 432 StrlSchV; §35 RöV) of 8th December 2003, BMU circular of 8/12/2003 - RS II 3 - 15530/1
- Guideline for the determination of body doses from external and internal radiation exposure, Part 2: Determination of the Body Dose in the Case of Internal Radiation Exposure (Incorporation monitoring) (§§ 40, 41 and 42 StrlSchV) of 12th January 2007
- Safety Criteria for the Final Disposal of Radioactive Waste in a Mine of 20th April 1983, Edition 3/84
- Nuclear Power Plant Safety Criteria: Promulgation of 21st October 1977 updated and replaced by the Safety Requirements for Nuclear Power Plants of 3rd March 2015 and the interpretations on this of 29th November 2013 as amended on 3rd March 2015, Edition 10/77
- Safety Requirements for Fuel Cycle Facilities of April 1997 and June 2004, BMU RS III 3
- Safety Requirements Governing the Final Disposal of Heat-Generating Radioactive Waste, As at 30th September 2010

- Safety Requirements for Nuclear Power Plants, Edition 03/15
- Interpretations of the “Safety Requirements for Nuclear Power Plants”, 3rd March 2015
- List of Contents and Structure of a Standard Safety Analysis Report for Nuclear Power Plants with Pressurized Water Reactor or Boiling Water Reactor, Edition 08/76
- Programme for the responsible and safe management of spent fuel and radioactive waste (National programme), August 2015
- Final Report of Commission on Storage of High-Level Radioactive Waste, 20th March 2018
- Framework Guideline on the Preparation of Expert Opinions in Nuclear Administrative Procedures, 15 December 1983
- Principles for authorised experts commissioned by federal supervisory authorities for nuclear power stations, July 2001
- Plan approval KONRAD, section ancillary provisions

[5] Guides and recommendations

- Recommendation of the Nuclear Waste Management Commission (ESK), 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
- Recommendation of the Nuclear Waste Management Commission (ESK), Guidelines for the decommissioning of nuclear facilities
- Recommendation of the Nuclear Waste Management Commission (ESK), Guidelines for dry cask storage of spent fuel and heat-generating waste, Revised version of 10th June 2013
- Recommendation of the Nuclear Waste Management Commission (ESK), ESK guidelines for the storage of radioactive waste with negligible heat generation, Revised version of 10th June 2013
- Recommendation of the Nuclear Waste Management Commission (ESK), Requirements for packages for the disposal of heat generating radioactive waste
- Recommendation of the Nuclear Waste Management Commission (ESK), Guideline on the safe operation of a disposal facility for in particular heat-generating radioactive waste
- Joint Recommendation by the Reactor Safety Commission (RSK) and the Radiation Protection Commission (SSK), Criteria for alerting the disaster control authority by the operators of nuclear facilities
- RSK statement (481st meeting of the Reactor Safety Commission (RSK) on 10th February 2016), Aspects of the determination of the site-specific design basis flood
- RSK statement (462nd meeting of the Reactor Safety Commission (RSK) on 6th November 2013), Assessment of the coverage of extreme weather conditions by the existing design
- RSK Statement (488th Meeting of the Reactor Safety Commission (RSK) on 3rd November 2016), Lightning with parameters above the standard lightning current parameters
- Recommendation of the Commission on Radiological Protection and the Reactor Safety Commission (SSK), General guidelines for emergency planning by nuclear power plant operators
- Recommendation of the German Commission on Radiological Protection (SSK), General Guidelines for Emergency Response in the Vicinity of Nuclear Installations
- Recommendation from the Commission on Radiological Protection (SSK), Guideline for Informing the Public in Nuclear Emergencies
- Recommendation by the German Commission on Radiological Protection (SSK), Basic Radiological Principles for Decisions on Measures for the Protection of the Population against Incidents involving Releases of Radionuclides

[6] KTA

- KTA-GS-63 (2013-01), Legal Basis and Procedures
- Notification concerning the Revised Version of the Notification concerning the Formation of a Nuclear Safety Standards Commission
- KTA Annual Report 2018 (in German)
- KTA Safety Standards

[7] Other law

- Act on the Implementation of Measures of Occupational Safety and Health to Encourage Improvements in the Safety and Health Protection of Workers at Work, as of 31st August 2015, Excerpt: Sections 15, 21
- Federal Civil Servants Act (BBG), as of 08th June 2017, excerpt: § 61
- Act to promote electronic government (E-Government Act – EgovG), as of 25th July 2013, Excerpt: section 9
- Industrial code (GewO), as of 17th October 2017, Excerpt: Section 139b
- German Commercial Code (HGB), as of 18th July 2017, Excerpt § 249
- Model Building Regulation (MBO), as of 13th May 2016, Excerpt § 14
- Criminal Code, as of 30th October 2017, Excerpt: §§ 89a, 126, 129a, 138, 140, 145, 306-330
- Environmental Information Act (UIG), as of 20th July 2017
- Environmental Impacts Assessment Act (UVPG), as of 12th February 1990, last Amendment of 8th September 2017, Excerpt §§ 1, 6, 16, 18, Annex 1
- Implementation law for the verification treaty and for the additional treaty and for the additional protocol (VerifZusAusfG), as of 29th January 2000, Excerpt § 2

[8] International treaties and EU Directives

- 23 international treaties and 7 EU directives were provided in the ARM

[9] BMU organisation

- Strategic Plan for the General Directorate RS
 - Annual Objectives 2018 BMU/RS Division
 - Annual Objectives 2019 BMU/RS Division
 - Achievement of annual objectives 2018; establishment of annual objectives 2019
- Directive for the processing and administration of written material (files and documents) in federal ministries (RegR)
- Framework Agreement on Co-operation in the Field of Nuclear Safety and Radiation Protection between the Federal Republic of Germany represented by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU) and Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH
- Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH, Articles of association, 26 August 2014
- Framework agreement for personnel development at the BMU
- Rules of Procedure of the BMU (GO-BMU)
- Joint Rules of Procedure of the Federal Ministries (GGO) as at 1st September 2011
- Handbook on Cooperation between the Federation and the Länder in Nuclear Law (as at June 2018)
- Germany's participation in the preparation of IAEA rules and regulations in the field of nuclear safety, Feb 2019
- Overview German members in international committees (bilateral commissions, EBRD, ENSREG, EU EURATOM, G7, HERCA, IAEA, KWU Regulator Group, OECD NEA, WENRA, others), 2019
- QM Manual – Directorate-General S
- Training concept for BMU employees including fields of competence and training concept of the Directorate-General S

- Information Notice on reportable events in nuclear power plants in the Federal Republic of Germany (IN 2016/02) – “Failure of a 6.3-/0.4-kV emergency power transformer by actuation of the Buchholz protection at the Isar 1 nuclear power plant”
- Information Notice on reportable events in nuclear power plants in the Federal Republic of Germany (IN 2018/05) – “Detachment of a Fuel Bundle From the Fuel Assembly’s Upper Plate” – Aspects of the Handling Impact on the Fuel Element Sup-port Structure – in NPP KRB-II-C on 05th November 2015”
- Information Notice on reportable events in nuclear power plants in the Federal Republic of Germany (IN 2018/03) – “Oil leakage from a main coolant pump with local flame formation at the Emsland nuclear power plant on 27th October 2013”
- Examples of Agenda/Schedule of the Technical Committee for Nuclear Safety (FA RS), Joint Meeting of the Radiation Protection Expert Committee (FAS) and the Länder Committee for the X-ray Ordinance (LA RöV), and of the Länder Committee for Nuclear Energy - Principal Committee (LAA)

[10] Länder references

- Bavarian Disaster Control Act (BayKSG) as of 24th July 1996, Excerpt Art. 1, 3, 3a, 6
- Act on Fire Protection, Assistance and Disaster Control of the Land of Brandenburg (Brandenburg Fire and Disaster Control Act - BbgBKG) as of 18th June 2018, excerpt: § 40, 48
- Ordinance of the Ministry of the Environment, the Ministry of Social Affairs and the Ministry of Rural Areas and Consumer Protection on responsibilities according to § 19 of the Atomic Energy Act and the Radiation Protection Ordinance (Radiation Protection Competence Ordinance - StrlSchZuVO), as of 17th January 2009
- Act on hazard prevention in the case of disasters (Disaster Control Act – KatSG) as of 9th May 2016, excerpt: § 5
- Management System of Department Nuclear Supervision, Radiation Protection, Ministry of the Environment, Climate Protection and the Energy Sector (UM BW)
- Examples of oversight practice
 - Administrative order of measures to rectify irregularities in in-service inspections
 - Communication of inspection findings
 - ISIS-notification, Daily report on the operation of the PWR plant
 - Finding by authorized expert
 - Notification of the reportable event 05/2004 at GKN II; Administrative offence under § 11 (1) AtSMV
 - Subsequent license condition
 - Notice Inspection Findings Cat B
 - On-site supervision of the Neckarwestheim site in 2017
 - Inspection report: Inspection concerning the fulfilment of the managers' responsibility in GKN I/II on 2nd August 2018
 - Supervision protocol GKN I
 - Inspections 2017 – Overview GKN site
 - GEA meeting on 18/07/2018 in KWO regarding the 2017 annual report
 - GEA (integrated event analysis) meeting on 08/08/2018 in KKP regarding the 2017 annual report
 - Service agreement regarding performance of appraisal interviews
 - Contents of MTO training seminars between 2011 and 2019
 - Note Human and organizational factors (HOF) in the supervision of decommissioning, 2017
 - TÜV letter to the Bavarian State Ministry of the Environment and Consumer Protection, related to Modification notice ÄA-2014/026
 - TÜV letter to the Bavarian State Ministry of the Environment and Consumer Protection, related to Modification notice ÄA-2014/029

- TÜV letter to the Bavarian State Ministry of the Environment and Consumer Protection, related to Amendment to the PHB checklist, 2019

APPENDIX VI - IAEA REFERENCE MATERIAL USED FOR THE REVIEW

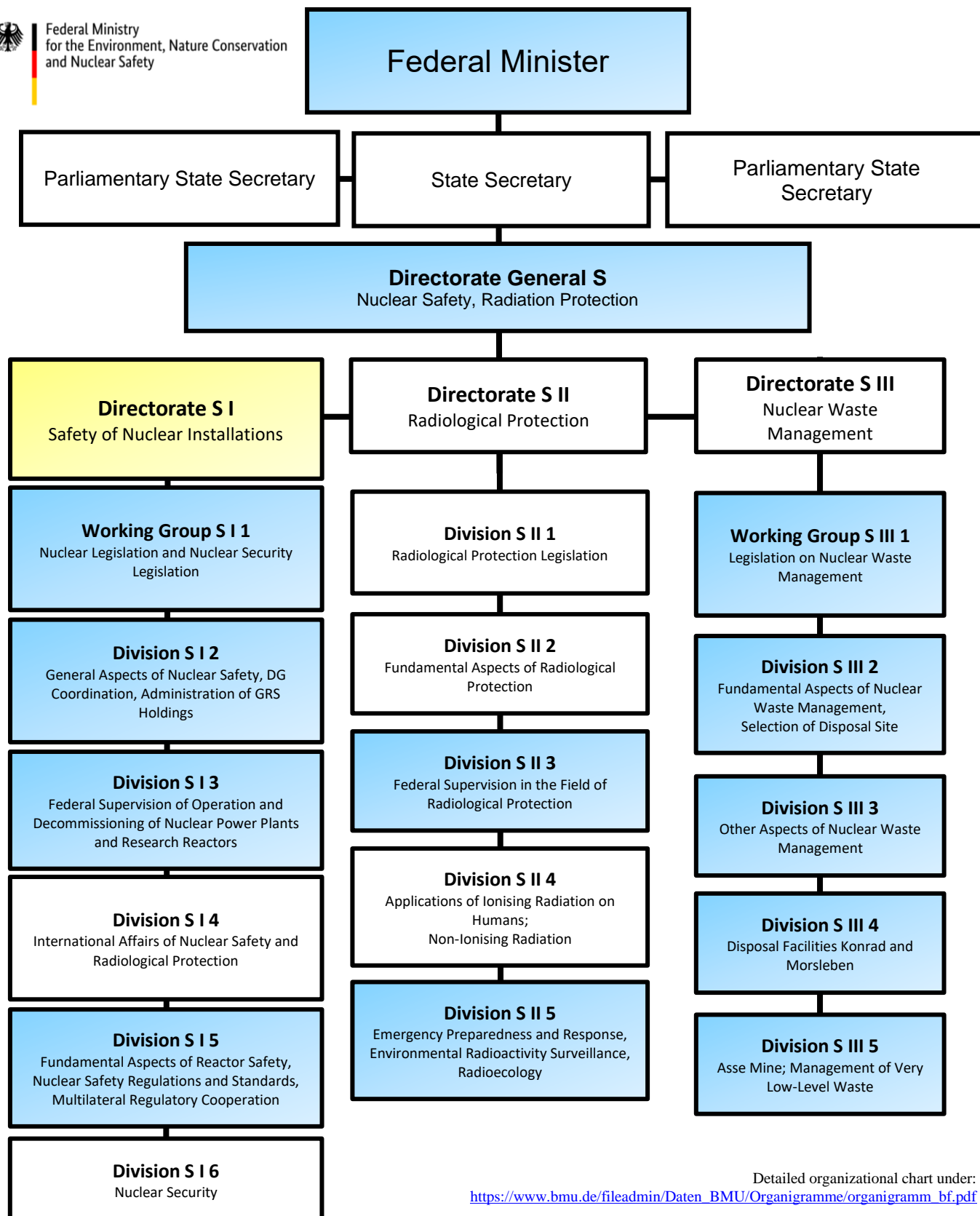
1. **IAEA SAFETY STANDARDS SERIES No. SF-1** – Fundamental Safety Principles
2. **IAEA SAFETY STANDARDS SERIES No. GSR PART 1 (Rev. 1)** – Governmental, Legal and Regulatory Framework for Safety
3. **IAEA SAFETY STANDARDS SERIES No. GSR PART 2** – Leadership and Management for Safety
4. **IAEA SAFETY STANDARDS SERIES No. GSR PART 3** – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards
5. **IAEA SAFETY STANDARDS SERIES No. GSR PART 4 (Rev. 1)** – Safety Assessment for Facilities and Activities
6. **IAEA SAFETY STANDARDS SERIES No. GSR PART 6** – Decommissioning of Facilities
7. **IAEA SAFETY STANDARDS SERIES No. GSR PART 7** – Preparedness and Response for a Nuclear or Radiological Emergency
8. **IAEA SAFETY STANDARDS SERIES No. SSR-2/1** – Safety of Nuclear Power Plants: Design
9. **IAEA SAFETY STANDARDS SERIES No. SSR-2/2** – Safety of Nuclear Power Plants: Commissioning and Operation
10. **IAEA SAFETY STANDARDS SERIES No. SSR-4** – Safety of Nuclear Fuel Cycle Facilities
11. **IAEA SAFETY STANDARDS SERIES No. SSR-5** – Disposal of Radioactive Waste
12. **IAEA SAFETY STANDARDS SERIES No. SSR-6** – Regulations for the Safe Transport of Radioactive Material
13. **IAEA SAFETY STANDARDS SERIES No. TS-R-1** – Regulations for the Safe Transport of Radioactive Material
14. **IAEA SAFETY STANDARDS SERIES No. GSG-6** – Communication and Consultation with Interested Parties by the Regulatory Body
15. **IAEA SAFETY STANDARDS SERIES No. GSG-12** – Organization, Management and Staffing of the Regulatory Body for Safety
16. **IAEA SAFETY STANDARDS SERIES No. GSG-13** – Functions and Processes of the Regulatory Body for Safety
17. **IAEA SAFETY STANDARDS SERIES No. GS-G-2.1** – Arrangements for Preparedness for a Nuclear or Radiological Emergency

18. **IAEA SAFETY STANDARDS SERIES No. GS-G-3.1** - Application of the Management System for Facilities and Activities
19. **IAEA SAFETY STANDARDS SERIES No. GS-G-3.2** - The Management System for Technical Services in Radiation Safety
20. **IAEA SAFETY STANDARDS SERIES No. RS-G-1.3** - Assessment of Occupational Exposure Due to External Sources of Radiation
21. **IAEA SAFETY STANDARDS SERIES No. RS-G-1.4** - Building Competence in Radiation Protection and the Safe Use of Radiation Sources
22. **IAEA SAFETY STANDARDS SERIES No. SSG-25** - Periodic Safety Review for Nuclear Power Plants
23. **IAEA SAFETY STANDARDS SERIES No. SSG-50** – Operating Experience Feedback for Nuclear Installations
24. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Convention on Early Notification of a Nuclear Accident (1986) and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1987), Legal Series No. 14, Vienna (1987).
25. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident, IAEA-TECDOC-955, IAEA, Vienna (1997)
26. **INTERNATIONAL ATOMIC ENERGY AGENCY** - General Safety Guide SGS-7 Occupational Radiation Protection
27. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Specific Safety Guide -46 Radiation Protection and Safety in Medical uses of Ionization Radiation

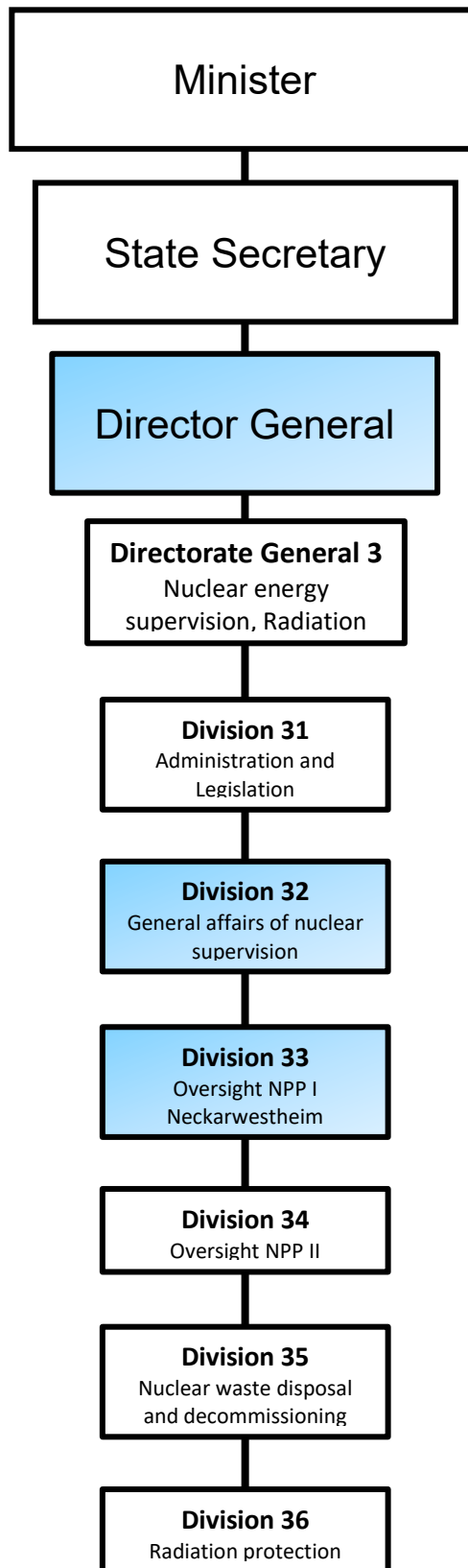
APPENDIX VII – ORGANIZATIONAL CHARTS



Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

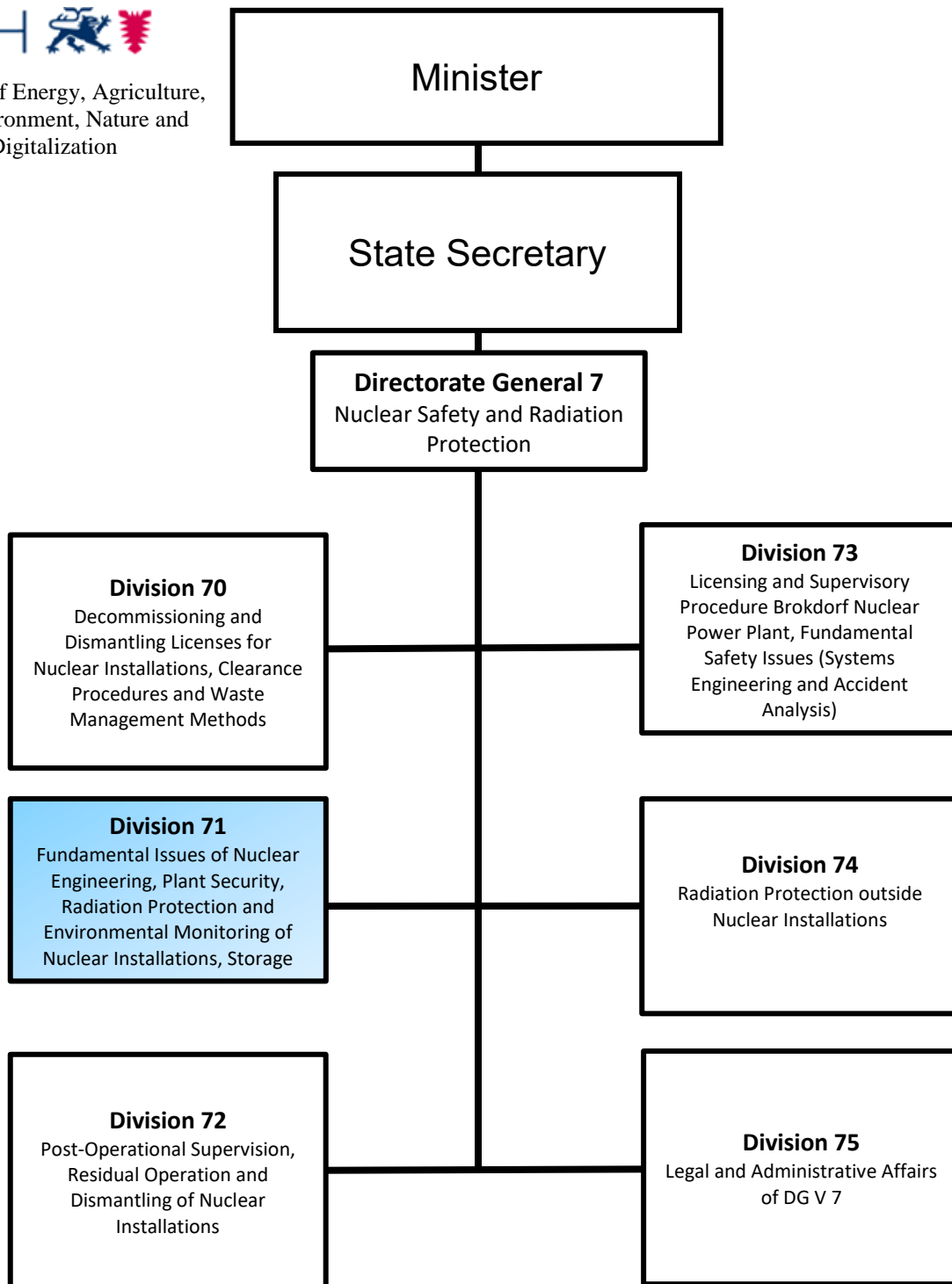


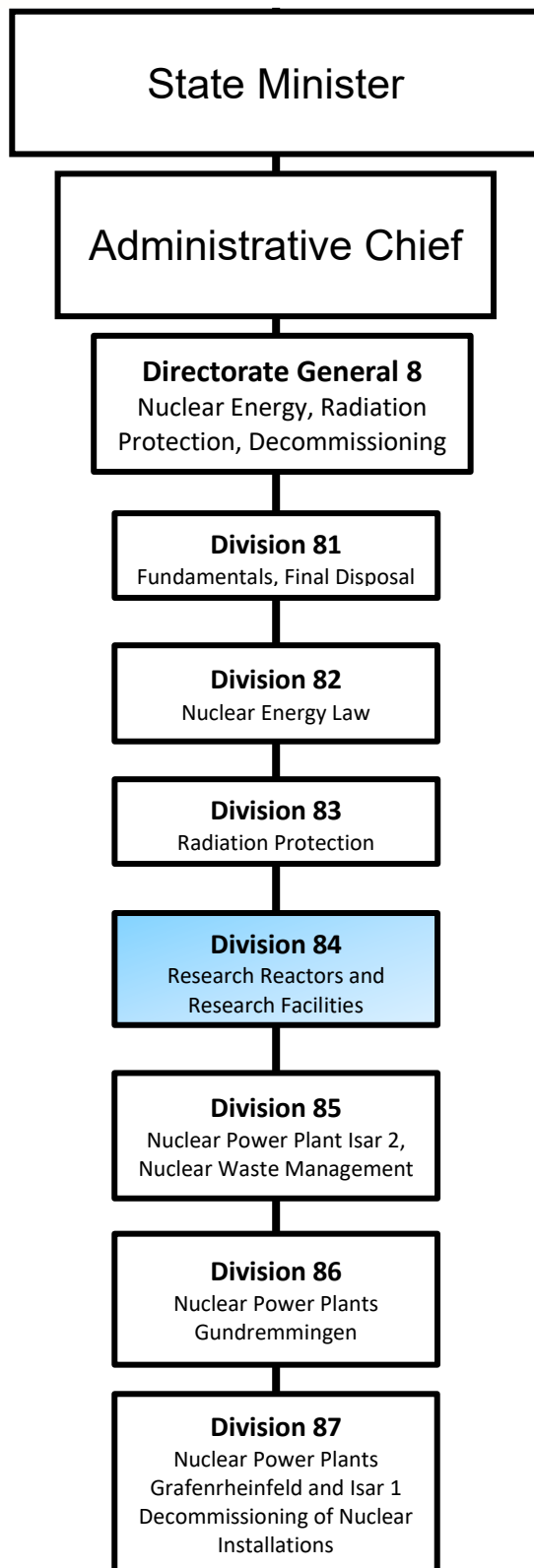
Detailed organizational chart under:
https://www.bmu.de/fileadmin/Daten_BMU/Organigramme/organigramm_bf.pdf



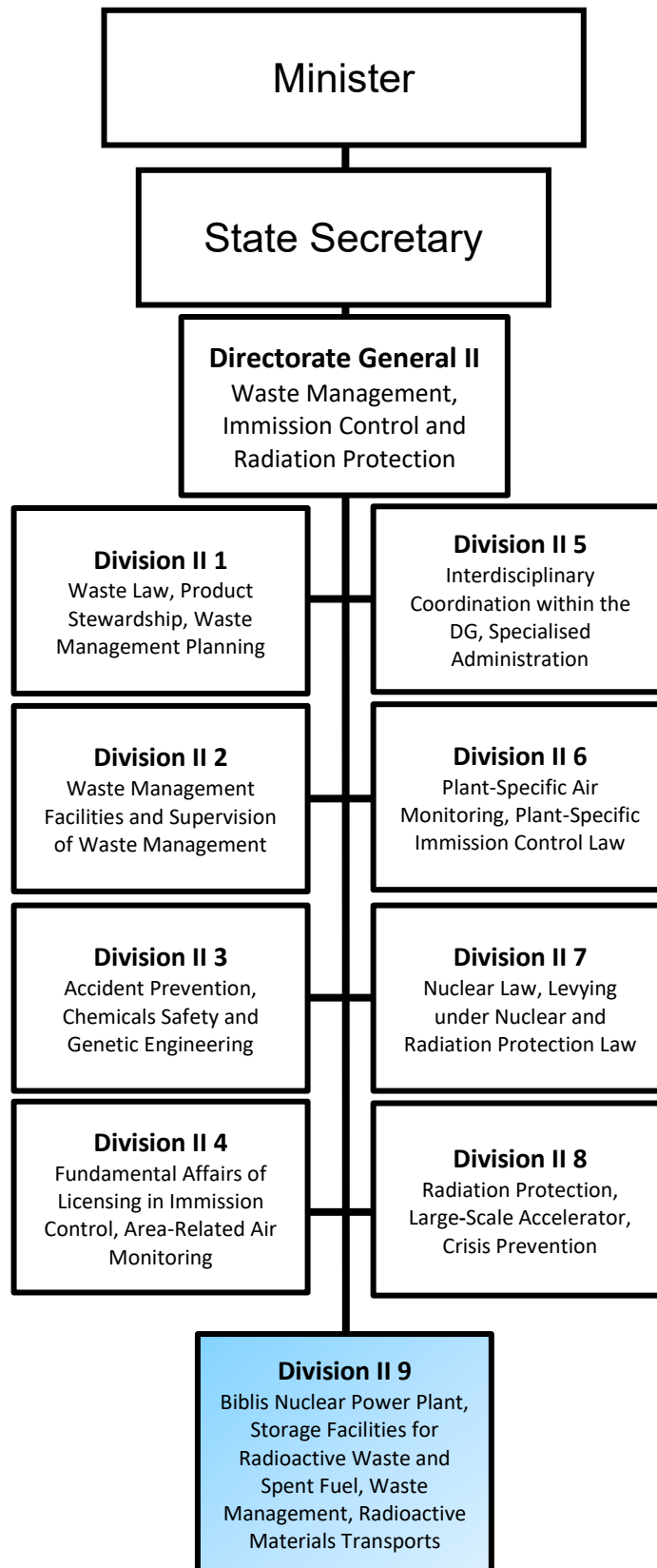
Detailed organizational chart under:

https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/1_Ministerium/Aufgaben_und_Organisation/180901_Organisationsplan.pdf



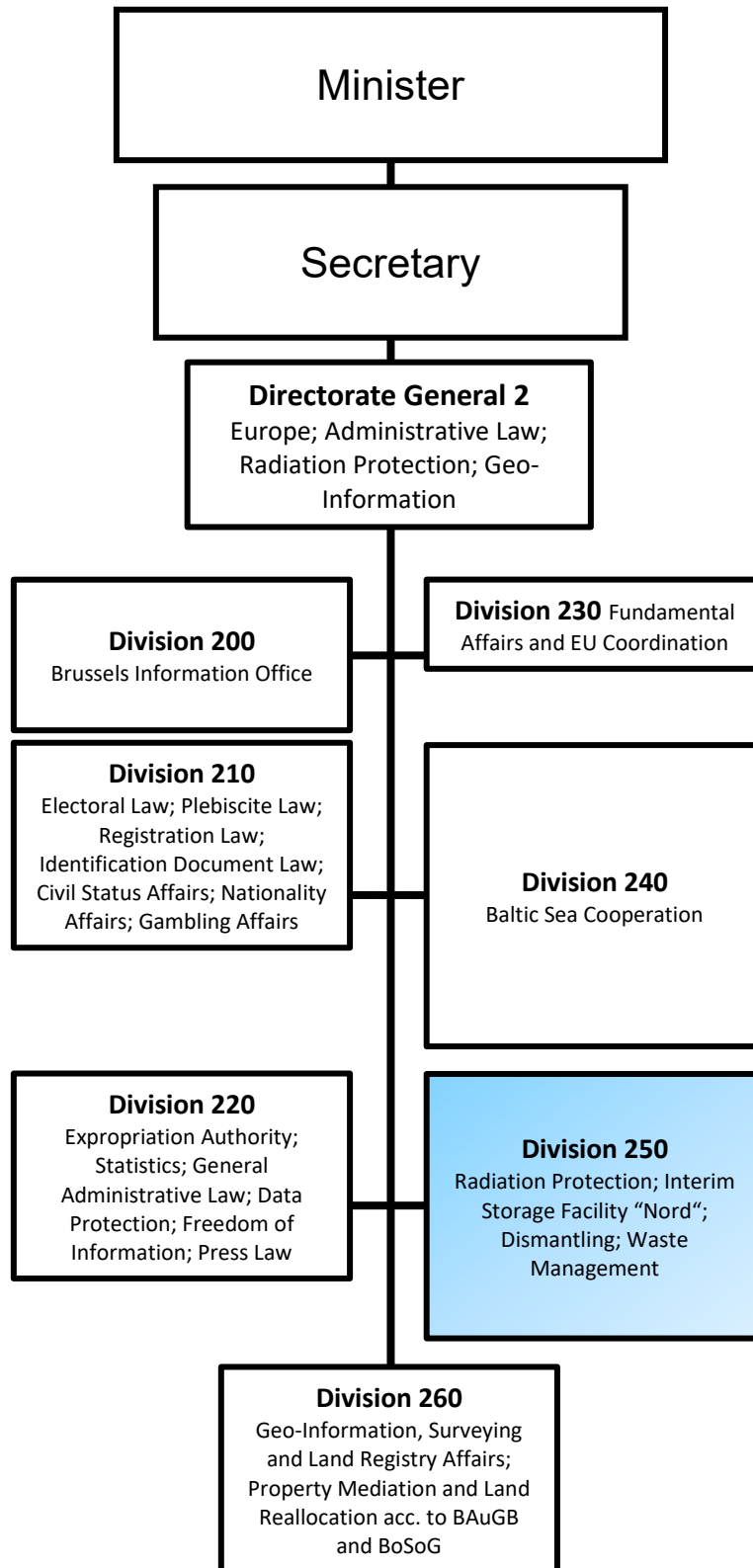


Detailed organizational chart under: <https://www.stmuv.bayern.de/ministerium/doc/org.pdf>



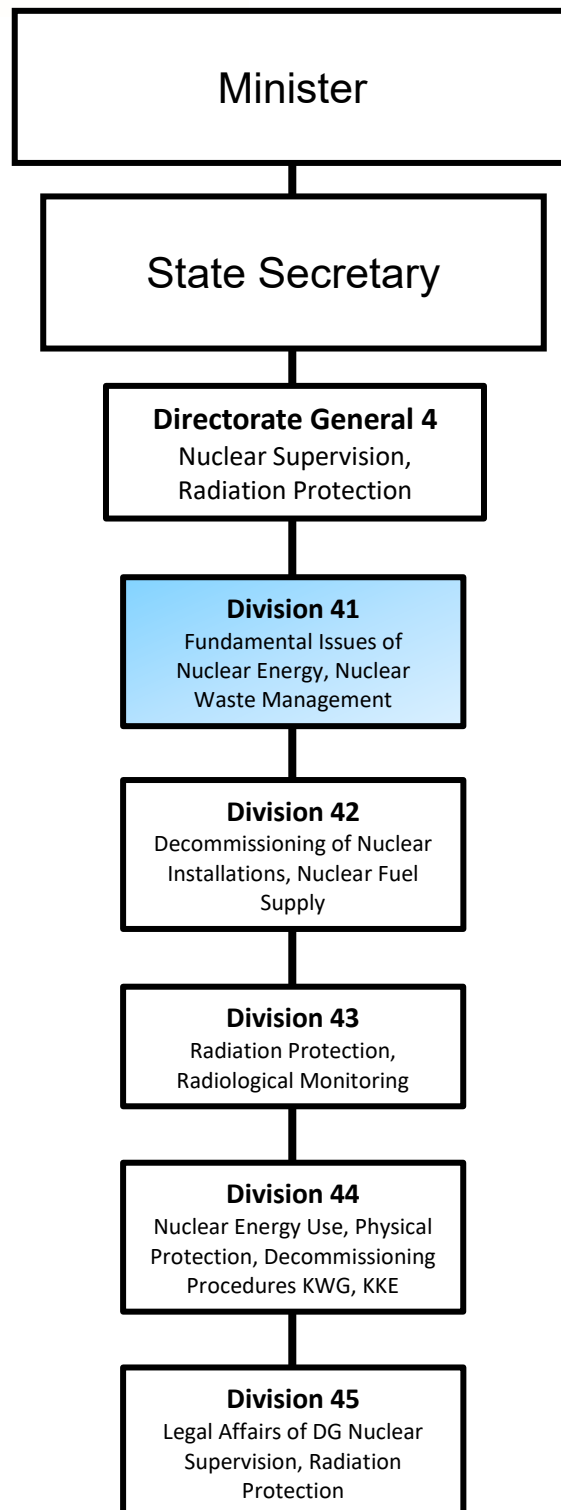
Detailed organizational chart under:

https://umwelt.hessen.de/sites/default/files/media/hmuelv/organisationsplan_1.8.2018.pdf



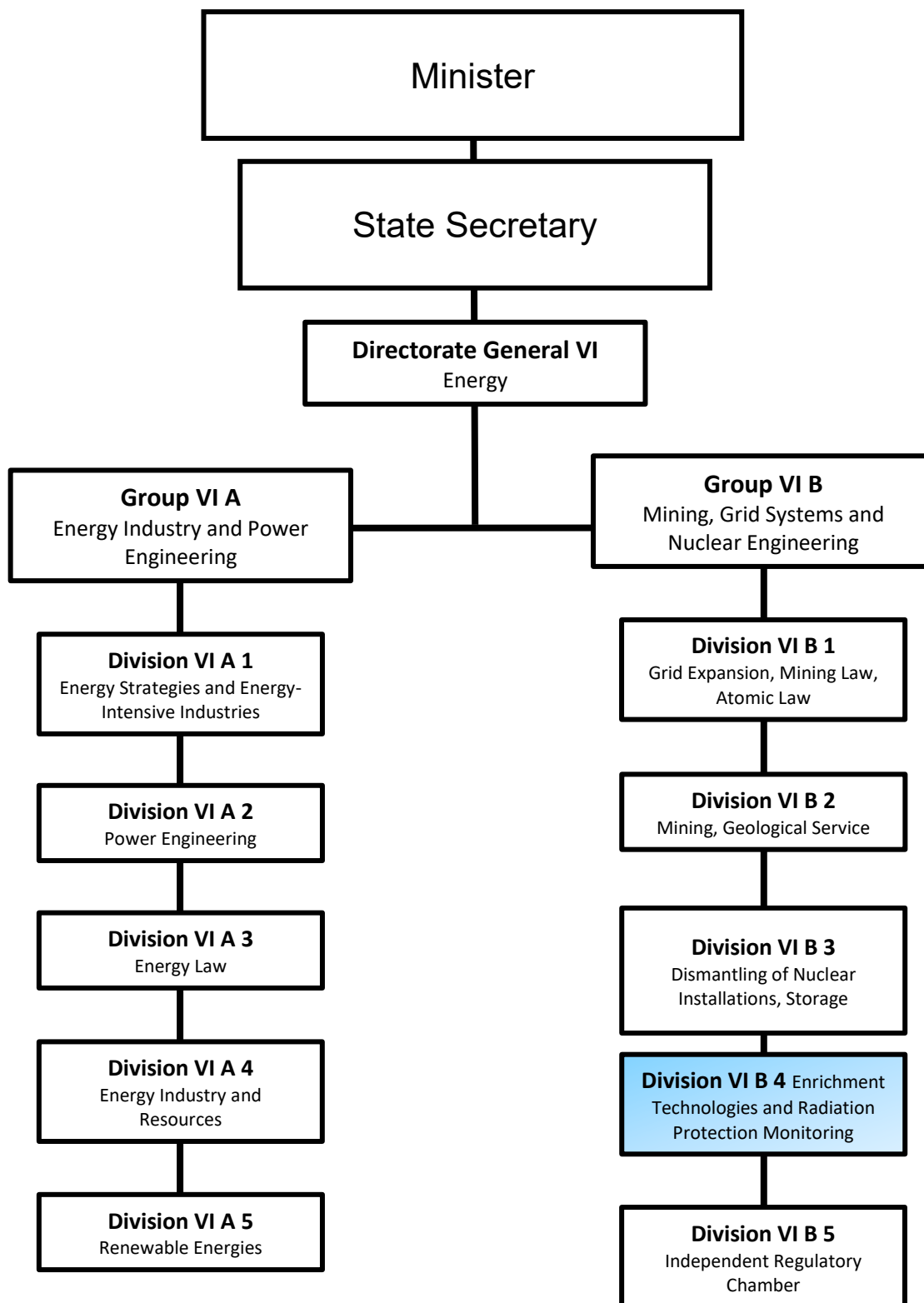
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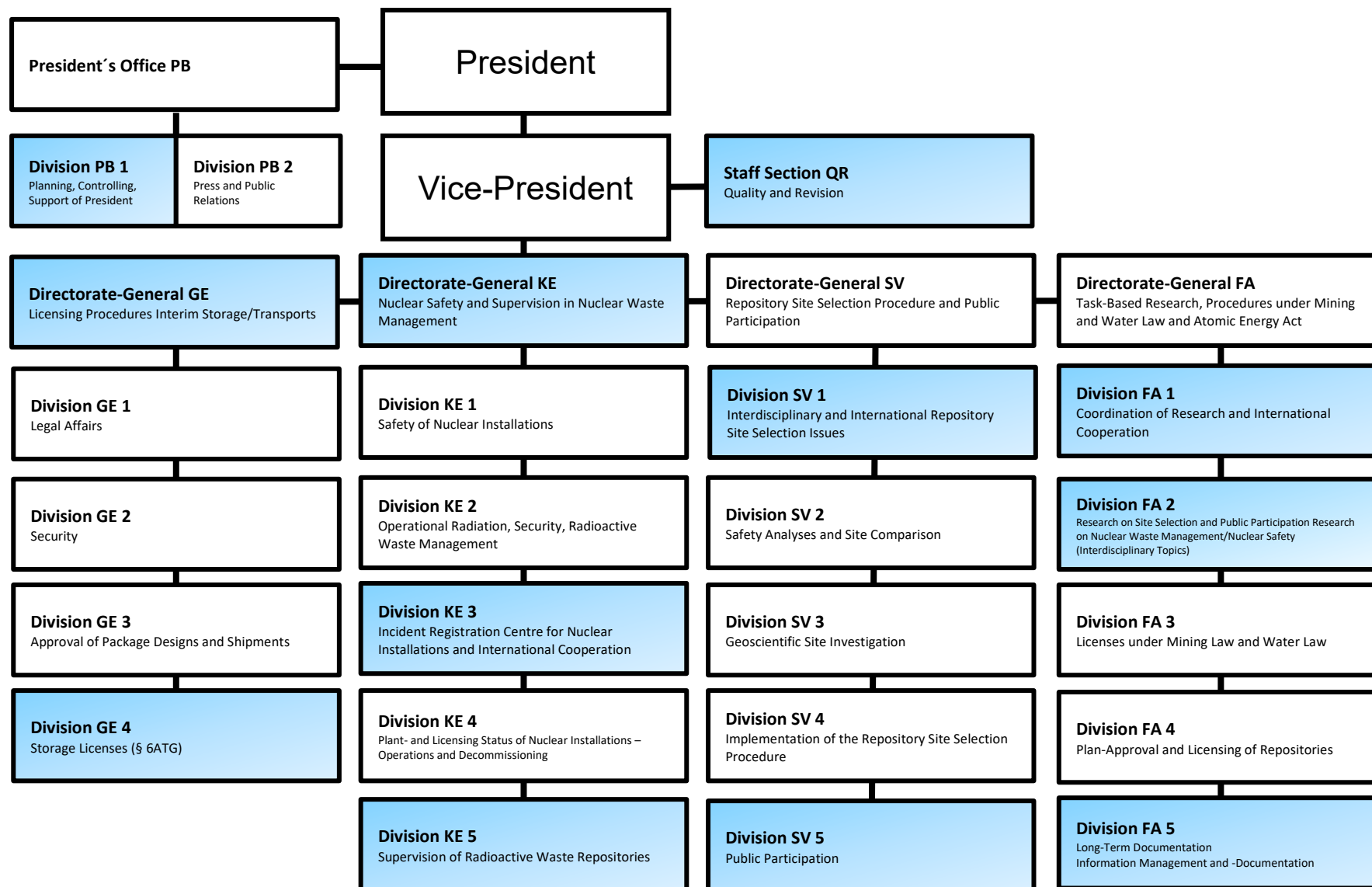
<https://www.regierung-mv.de/Landesregierung/im/Ministerium/Organigramm/>



Detailed organizational chart under:

http://www.umwelt.niedersachsen.de/download/7400/Organisationsplan_Stand_28.08.2018_.pdf



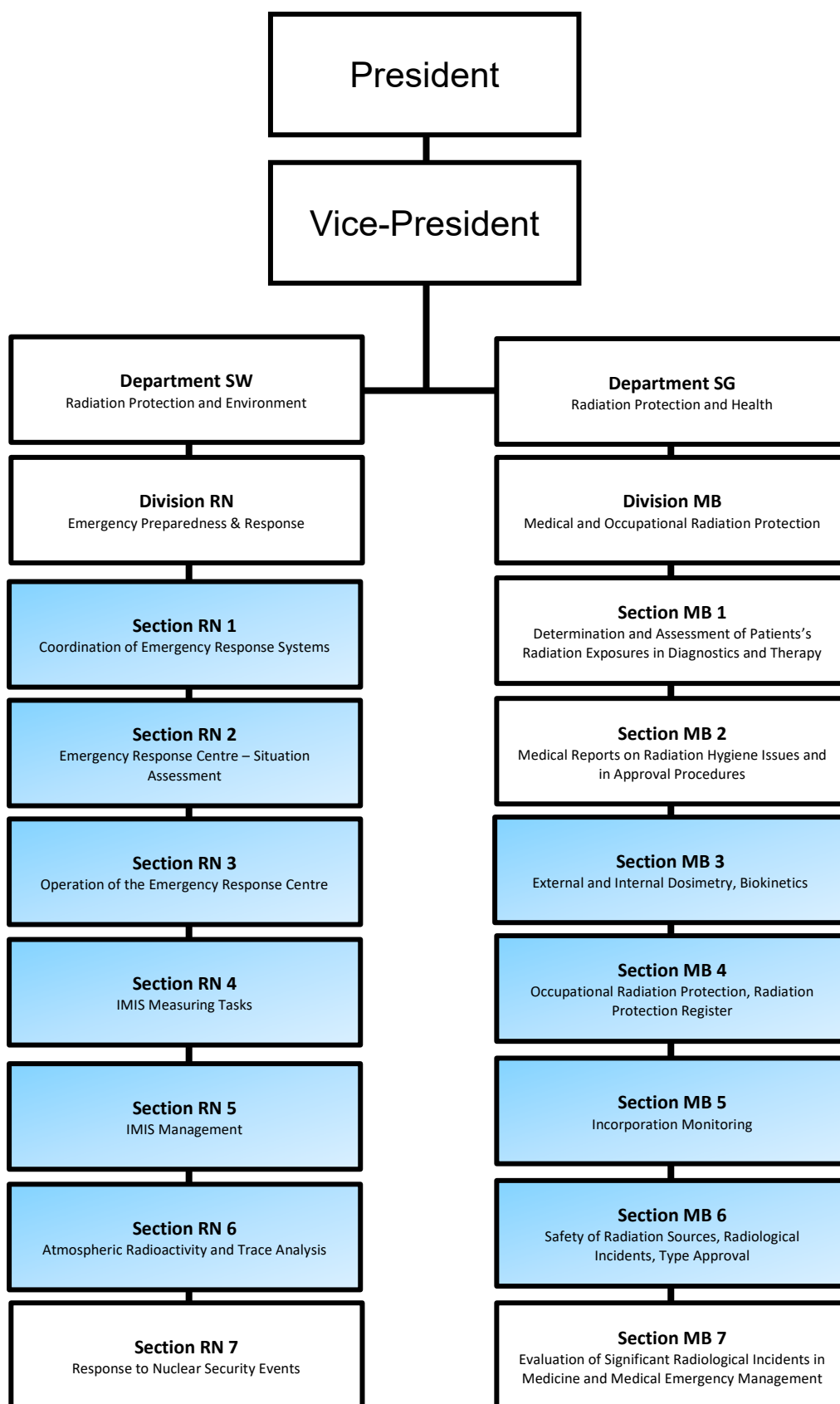


Detailed organizational chart under:

https://www.bfe.bund.de/SharedDocs/Downloads/BfE/DE/bfe/organigramm-de.pdf?__blob=publicationFile&v=32



The Federal Office for Radiation Protection



Detailed organizational chart under:

<http://www.bfs.de/SharedDocs/Downloads/BfS/DE/bfs/organigramm-de.html>