RADIOACTIVE WASTE MANAGEMENT PROGRAMMES IN OECD/NEA MEMBER COUNTRIES

GERMANY

[2016]

NATIONAL NUCLEAR ENERGY CONTEXT

The commercial use of nuclear power in Germany started in 1961. The peak value of installed nuclear capacity was reached in 1994, when 21 nuclear power plants were in operation with an installed capacity of 23.9 GWe. Due to the gradual decommissioning of older nuclear power plants, the installed capacity had decreased to a value of 11.4 GWe by 2015.

With the 13th amendment of the Atomic Energy Act of 6 August 2011, the licenses to operate the plants Biblis A and B, Neckarwestheim I, Brunsbüttel, Isar 1, Unterweser, Philippsburg 1 and Krümmel expired immediately while Grafenrheinfeld ceased operation in June 2015 with the license expiring by the end of 2015. The operating licenses of the remaining eight nuclear power plants will expire between 2017 and the end of 2022 at the latest. The amendment of the Atomic Energy Act was a consequence of the events in Japan in March 2011, which led to a reassessment of the risks associated with the use of nuclear energy.

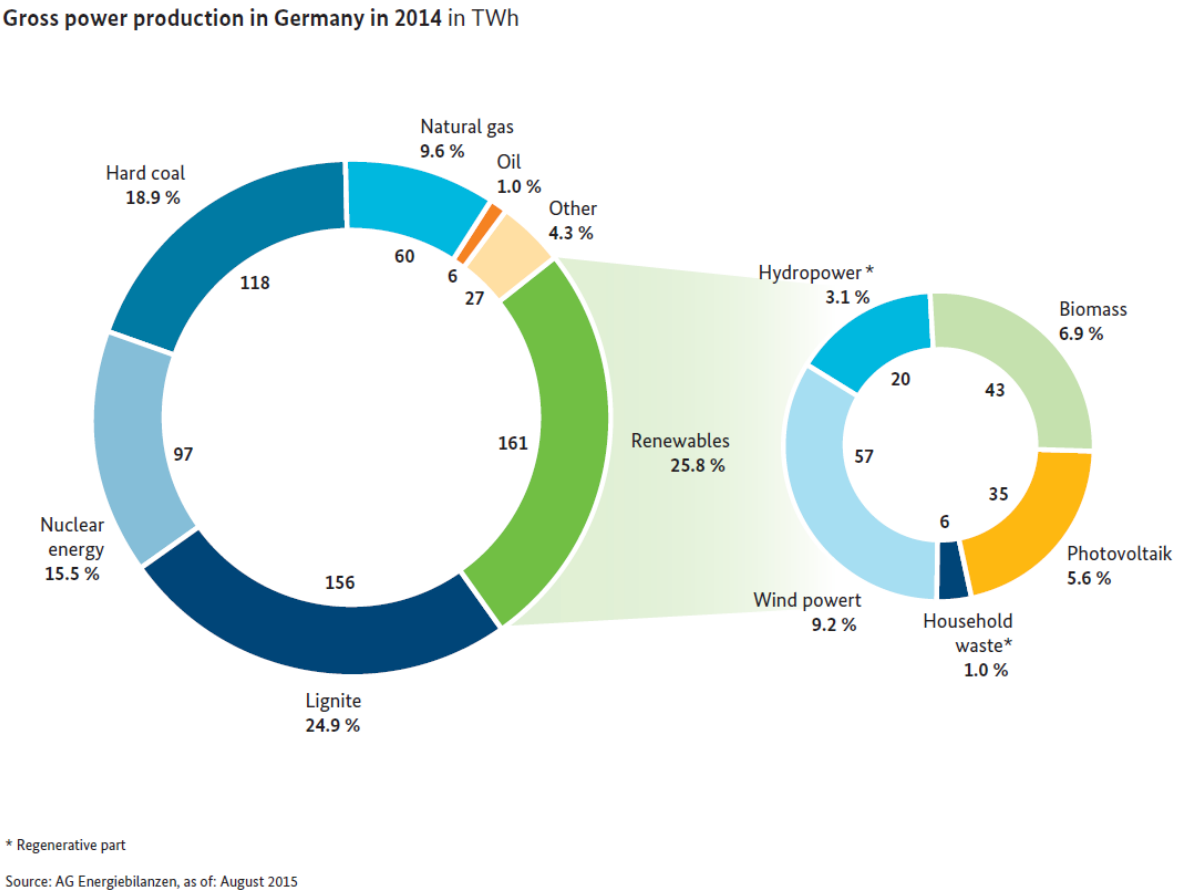
At the end of 2015, the capacity for nuclear fuel fabrication was 650 tonnes of heavy metal per year (HM/year), yielding uranium fuel for light water reactors. The Gronau uranium enrichment plant had reached a capacity of 4,325 tons SWU per year (the licensed capacity is 4,500 tons SWU per year). The spent fuel storage capacity of the at-reactor dry storage facilities was 14,025 tonnes HM. 450 tonnes HM thereof are at the Brunsbüttel facility, whose license was finally revoked in January 2015 due to procedural errors. The storage of the spent fuel is currently based on an order issued by the competent supervisory authority of Schleswig-Holstein. The operator of the interim storage facility applied for a new licence for storing the spent fuel in transport and storage casks in the interim storage facility. The amount of spent fuel arising annually from the eight reactors in operation was about 166 tonnes HM.

According to the Atomic Energy Act (§7 para. 1a), the licenses for the eight nuclear power plants (NPP) to be operated expire by

- end of 2017 for the NPP Gundremmingen B,
- end of 2019 for the NPP Philippsburg 2,
- end of 2021 for the NPPs Grohnde, Gundremmingen C and Brokdorf,
- end of 2022 for the NPPs Isar 2, Emsland and Neckarwestheim 2

at the latest.

Fig. 1: Breakdown of power production in Germany in 2014, as of August 2015



Following EU Council Directive 2011/70/EURATOM, the German Programme for the responsible and safe management of spent fuel and radioactive waste (National Programme) was transmitted to the EU Commission in August 2015.

SOURCES, TYPES AND QUANTITIES OF WASTE

A detailed breakdown of the current inventory of radioactive waste can be found in the report Inventory of Radioactive Waste[1]. This inventory is updated every three years.

Spent fuel and waste from reprocessing

Current Inventory

As at 31 December 2014, about 8,380 Mg HM[2] have been generated in the form of spent fuel assemblies (FA) from the operation of nuclear power plants in the Federal Republic of Germany which have to be disposed of directly in the Federal Republic of Germany. Their current storage locations are shown in Tab. 1.

[1] Available online as supplementary material for the National Programme

[2] Megagrams of heavy metal (Mg HM) is the unit of the mass of heavy metal and hence a measure for the fuel content (uranium and plutonium) of a fuel assembly.

Tab. 1: Inventory of spent fuel from German nuclear power plants, stored in Germany, as at 31 December 2014

Storage location	Casks	Fuel assemblies	Mass
Nuclear power plant storage pools*		14,013 FA	4,258 Mg HM
Dry cask storage in on-site storage facilities	352	9,638 FA	3,444 Mg HM
Dry cask storage in the transport cask storage facilities at Ahaus, Gorleben and Rubenow	76	5,343 FA	677 Mg HM
	Total:	**28,994 FA**	**8,379 Mg HM**

* including the wet storage facility at the site of the Obrigheim nuclear power plant, which is being decommissioned, and the reactor core of the permanently closed down Brunsbüttel nuclear power plant

Vitrified high-level radioactive waste from the reprocessing of spent fuel in other European countries and in Germany is stored in 113 casks in the Gorleben transport cask storage facility and the transport cask storage facility "Zwischenlager Nord" at Rubenow.

The amount of spent fuel from German experimental and demonstration reactors yet to be disposed of are in dry storage in 461 casks in the Ahaus storage facility, at the research centre Forschungszentrum Jülich, and in the Zwischenlager Nord storage facility.

The amount of spent fuel from research reactors is less by several orders of magnitude than the amount from nuclear power plants and is stored by the research reactors in Berlin, Garching and Mainz as well as in 18 casks in the Ahaus storage facility.

Prediction

In all, the assumption is that about 10,500 Mg HM in the form of spent fuel assemblies (including the amount that has already accumulated) will be generated in nuclear power plants and will have to be disposed of. Tab. 2 shows the amounts of vitrified high-level radioactive waste from reprocessing of spent fuel that has already been returned from France and from the United Kingdom and the amounts of waste still expected.

Tab. 2: Prediction (including current inventory) of the amounts of radioactive waste from reprocessing that has to be disposed of in the Federal Republic of Germany (as at 31 December 2014)

	Canisters	Casks
Vitrified high-level radioactive waste from France	3,024	108
Vitrified medium-level radioactive waste from France	140	5
Medium-level radioactive waste from France compacted under high pressure	4,104	152
Vitrified high-level radioactive waste from the United Kingdom	571	21
Vitrified high-level radioactive waste from reprocessing in Karlsruhe	140	5
Total	**7,979**	**291**

From the research reactors, a waste volume in the range of 10 to 12 Mg HM is expected.

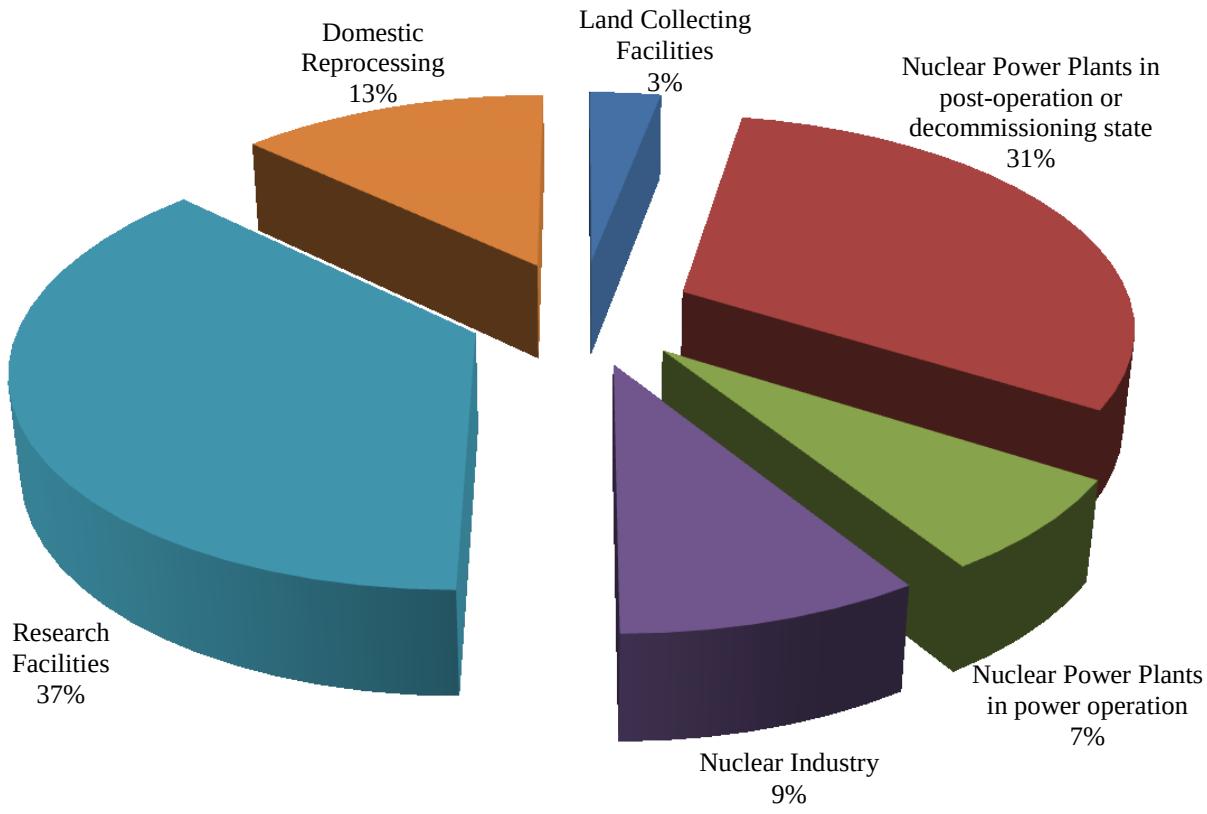
As regards the research reactor in Berlin, contracts exist governing the return shipment of spent fuel assemblies generated until the year 2016 to their country of origin

Other radioactive waste (waste with negligible heat-generation)

Current inventory

The current inventory of other radioactive waste is shown in Tab. 3. The breakdown into groups of originators of the total conditioned radioactive waste volume of around 117,000 m³ existing as at 31 December 2014 is shown in Fig. 2.

Fig. 2: Breakdown of the current inventory of other conditioned radioactive waste by groups of waste originators as at 31 December 2014



Tab. 3: Current inventory of other radioactive waste (as at 31 December 2014)

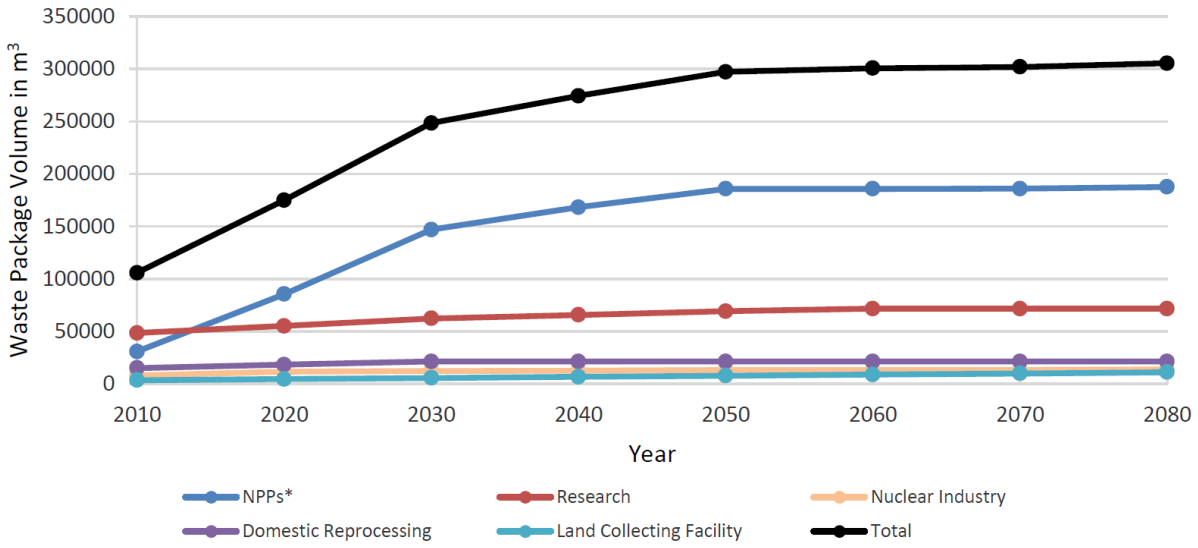
Processing condition	**Amount**
Primary waste and pre-treated waste	21,662 Mg
Conditioned waste products	16,908 m³
Waste packages for disposal	100,288 m³

Prediction

The time pattern of the cumulated amount of radioactive waste with negligible heat generation as it is expected by the waste originators and which according to the valid plan approval decision are to be emplaced in the Konrad disposal facility is shown in Fig. 3. After 2045, no

larger amounts of waste from the decommissioning of nuclear power plants are expected any more.

Fig. 3: The time pattern of the cumulated amount of radioactive waste with negligible heat generation as it is expected by the waste originators and which according to the valid plan approval decision are to be emplaced in the Konrad disposal facility, shown as waste package volume until the year 2080



*this also includes the waste volumes of the federally-owned Energiewerke Nord GmbH

In the Asse II mine, around 47,000 m³ of low- and medium-level radioactive waste have been emplaced. According to current estimates, the retrieval will produce an accumulation of at least 90,000 Mg of unconditioned waste; after conditioning, this will result in a waste volume of approx. 175,000 to 220,000 m³ for later disposal.

In case that there will be no further reutilisation, the expected waste package volume of waste resulting from uranium enrichment is up to 100,000 m³ of depleted uranium.

RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

Management of the spent fuel from power reactors and the waste from reprocessing

Storage

Spent fuel from power reactors and waste from reprocessing is stored in transport cask storage facilities. Apart from the on-site storage facilities at the nuclear power plant sites, there are the transport cask storage facilities at Gorleben and Ahaus and the "Zwischenlager Nord".

Presumably by the year 2027, all fuel assemblies used in the nuclear power plants will have been placed in a total of about 1,100 transport and storage casks and removed to transport cask storage facilities. The radioactive waste to be returned from reprocessing has also been placed in transport and storage casks. For this waste from reprocessing, a total of 291 transport and storage casks are needed according to a current prediction (see also Tab. 2.2).

The dry storage of spent fuel and waste from reprocessing in transport and storage casks has proved to be effective. In Germany, there are sufficient storage capacities available for accommodating all spent fuel and radioactive waste from reprocessing.

According to the licences that have been granted, the storage periods for transport and storage casks are limited to 40 years because the safety of the casks has not been proven for a longer period. According to current findings it cannot be guaranteed that the storage facilities will be fully cleared during this period. Hence the technical prerequisites for a prolonged storage at the sites of the storage facilities and in transport cask storage facilities are currently being examined.

Disposal

On 27 July 2013[3], the Act on the search for and selection of a site for a disposal facility for heat-generating radioactive waste and for the amendment of other laws – the so-called Site Selection Act (Standortauswahlgesetz – StandAG) – entered into force. The aim of the site selection procedure according to the Site Selection Act is to find the site for a disposal facility especially for high-level radioactive waste. This disposal facility is to take in especially spent fuel and waste from reprocessing. In 2014, the German Bundestag and Bundesrat began the implementation of the Act by setting up the *Commission on Storage of High-Level Radioactive Waste*. This Commission will present a final report in 2016; on the basis of the report, parliament is expected to revise the Site Selection Act.The selection procedure for the site of this disposal facility is to be concluded by the year 2031. The planning of this disposal facility considers not only the spent fuel and waste from reprocessing but also the radioactive waste with negligible heat-generation that may not be suitable for emplacement in the Konrad disposal facility. This concerns radioactive waste that owing to its nuclide inventory and/or its chemical composition or the time of its generation is not suitable for emplacement in the Konrad disposal facility.

Furthermore, the radioactive waste to be retrieved from the Asse II mine is to be taken into account in the search for a site for this disposal facility. The same applies to the depleted uranium that has been generated and will be generated as a result of uranium enrichment, providing for the case that it will not be reutilised. It will only be possible to reach a final decision on the location of the disposal facility site for this waste - taking into account all technical, economic and political aspects - once the criteria for emplacement in the disposal facility site according to the Site Selection Act have been determined and sufficient information is available on the volume and properties of the radioactive waste to be retrieved from the Asse II mine and on the time of this waste's generation.

The Site Selection Act mentions rock salt, clay and crystalline rock as possible host rock types. Research and development activities regarding all three host rock types have already been carried out for many years. The available research results are considered in the exploration, assessment and designation of regions in Germany with potentially suitable host rock formations.

Once a disposal facility site according to the Site Selection Act has been determined, a receiving storage facility with a corresponding conditioning plant is to be constructed at the same site. This would create the conditions to commence the clearance of the existing storage facilities. The Federal Government plans to take the disposal facility into operation around the year 2050. The time needed for the actual emplacement depends on the disposal facility concept.

[3] Some of the regulations of this Act entered into force on 1 January 2014.

The fact that the Site Selection Act has entered into force means that the basis for the search for a disposal facility especially for heat-generating waste has been established. The selection steps, time marks, responsibilities and tasks of the organisations involved as well as the broad involvement of the general public in the selection process, all of which is stipulated in the act, form the basis for a transparent and comprehensible procedure.

Management of waste with negligible heat-generation

Conditioning and storage of waste

The radioactive waste that is delivered to the Konrad disposal facility has to comply with the waste acceptance requirements for disposal that apply to this disposal facility according to the plan approval. To this end, the radioactive waste has to be correspondingly conditioned and subjected to product control by the Federal Office for Radiation Protection (BfS) to verify compliance with the waste acceptance requirements for disposal. Product control comprises i.a. examinations of the radiological and material composition, type approval of waste containers, random sampling of waste packages, and the qualification of conditioning measures.

Until they are delivered to the Konrad disposal facility, the radioactive waste with negligible heat-generation remains in storage facilities, Land collecting facilities or a collecting facility of the armed forces, which have their own waste acceptance requirements for storage, respectively. Depending on the date of the commissioning of the Konrad disposal facility and the specific arrangements of the demand and delivery regime, it must be expected that even waste packages that have been conditioned to meet the waste acceptance requirements for disposal and have undergone product control will still have to be stored over longer periods of time. Insofar the capacities of the storage facilities have to be appropriately adapted. Already now, the nuclear power plant operators as well as the operators in the area of the public sector are planning additional storage capacities for the waste generated during the decommissioning of their installations.

Konrad disposal facility

The Konrad disposal facility, which is in the process of being constructed, has a plan approval to take in up to 303,000 m³ of radioactive waste with negligible heat-generation. Construction planning and work are underway.

Emplacement operation for the licensed waste volume of 303,000 m³ is not to exceed 40 years.

The Konrad disposal facility is intended for the emplacement of radioactive waste with negligible heat-generation from the operation and dismantling of the nuclear power plants as well as from industrial, medical and research applications.

According to the plan approval concrete verification has to be provided prior to the approval of the final operational plan – i.e. towards the end of disposal facility operation – showing that the protection of third parties will be ensured according to the state of the art in science and technology also after the cessation of operation of the facility. At present, there is no special official control and monitoring programme intended after closure of the facility. The plan approval demands that routine environmental measurements of the air, water and soil be carried out for the area of the disposal facility.

Asse II mine

The Asse II mine is a former potassium and rock salt mine. Between 1967 and 1978, about 47,000 m³ of low-level and medium-level radioactive waste were emplaced in the Asse II mine.

The saline solutions entering into the underground structure of the mine and the stability problems caused in the mine by the extensive mine workings led to the decision to decommission the Asse II mine. With the entry into force of the Act to speed up the retrieval of radioactive Waste from and the closure of the Asse Mine (Lex Asse) on 25 April 2013, the retrieval was legally fixed as the option to be pursued for decommissioning. The aim is to retrieve the waste emplaced in the Asse II mine unless the execution of the retrieval should be unjustifiable for the public and/or the workers for radiological or other safety-relevant reasons.

According to current planning, retrieval cannot start prior to the year 2033; efforts are undertaken to allow an earlier start. The waste is to be conditioned on-site and stored until its disposal in a storage facility that is to be newly constructed.

Morsleben disposal facility for radioactive waste

Emplacement in the Morsleben disposal facility for radioactive waste, where around 37,000 m³ of low-level and medium-level radioactive waste was emplaced until 1998, has been concluded. The disposal facility is to be closed and safely sealed for the long term.

RESEARCH AND DEVELOPMENT

Background

According to the Atomic Energy Act (AtG, § 9a para. 3), the provision of disposal facilities for radioactive waste is a federal task. Hence, besides the provision of the scientific and technical basis for the realisation of a disposal facility, the Federal Government also has to make provisions for continuously furthering the state of the art in science and technology through corresponding research and development (R&D) and has to contribute substantially to building up, developing and maintaining the scientific and technical competence as well as to promoting young experts in this field.

There are different branches of R&D on radioactive waste management in Germany:

- R&D related to the implementation of the site selection procedure for a disposal facility for high level waste.
- Facility-related R&D necessary for the erection of German waste disposal facilities.
- Applied R&D that is independent of preparatory work on disposal facilities, and comes under the general objective of continually improving the protection of man and the environment.

The above mentioned branches are different in terms of the following aspects:

- Legal basis for the respective R&D
- Financing of R&D work

- Responsibilities and grant of funds

According to § 21 of the Site Selection Act (StandAG, entered into force on July, 23rd 2013) the licensee and the Federal Office for Nuclear Waste Management (BfE) allocate their costs i.a. for R&D related to the implementation of the site selection procedure proportionately on the obliged parties for the allocation. Obliged parties according to § 22 of the StandAG are those who have to deliver radioactive waste to a disposal facility.

The costs and contributions regarding facility-related research and development are regulated according to § 21 of the AtG. In principle, the parties obliged to surrender material, e.g. radioactive waste which is destined for waste disposal, shall be charged with costs (fees and expenses).

The energy research programme of the Federal Government names the guideline for the future federal research and development sponsorship in the energy sector, thereby describing, for example, the research-political orientation with respect to the sponsorship area of nuclear safety and waste management research. Corresponding research and development sponsorship concepts of the competent ministries put these general conditions in concrete terms and predetermine defined research focuses that are relevant for the sponsorship period. In this context, international co-operation plays an important role. The costs of R&D work are covered through the provided budget of the energy research programme approved by the German parliament. The legal basis for grants of related research projects builds the Federal Budgetary Regulations together with the general administrative provisions and the provision 800/2008 of the European Union (EU).

Overview Research Activities

The general programmatic fundamentals as well as the research objectives and promotion areas in the field of disposal are formulated in the current 6th Energy Research Programme of the Federal Government, "Research for an environmentally sound, reliable and affordable energy supply". This programme is a joint project of the Federal Ministry for Economic Affairs and Energy (BMWi) as the lead-management organisation, the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) and the Federal Ministry of Education and Research (BMBF).

The research activities in the fields of nuclear safety and radioactive waste management are carried out under the auspices of BMWi by German research institutions as part of international co-operation. These activities are for the most part performed within the framework of bilateral agreements with repository organisations, by way of project-funded participation in consortia, in EU projects as co-financed work, and as part of direct contractual agreements and work within the framework of scientific and technical co-operation.

Apart from the scientific and technical gain, the research that is carried out contributes to the continual development of the state of the art in science and technology and hence to the fulfilment of the stringent requirements of i.a. the AtG for the safety of the handling of radioactive waste.

A significant contribution in the area of support given to national and international repository research is made by the German Association for Repository Research (Deutsche Arbeitsgemeinschaft Endlagerforschung – DAEF), which was founded on 16th January 2013. The DAEF serves for the furthering and intensification of the co-operation of its members (research institutes and centres, universities etc.) in the field of repository research and offers

scientific and technical advice to the federal government and its authorised federal and Länder authorities as well as to the Bundestag and other interested institutions.

A further, quite considerable part of the research is done as part of international co-operation. This is based on bilateral and multilateral agreements with foreign institutions within the framework of the participation in international research projects. Moreover, activities like these are carried out in the research framework programmes of the EU.

Activities in connection with the „Implementing Geological Disposal of Radioactive Waste – Technology Platform“ (IGD-TP) take place in a special context of international cooperation. On the basis of the strategic and programmatic documents, the research agenda and a deployment plan, key issues for all repository concepts are defined and national as well as international research is carried out.

For more than three decades, German scientists have been involved in international research projects on waste management and repository research with the aim to build up and expand experience and knowledge as well as to obtain the necessary expertise in connection with the application and use of methods and technologies. As Germany does not have its own underground laboratory co-operation – especially in underground laboratories (Mt. Terri (CH), Grimsel(CH), Äspö (S), Bure (F)) – and the participation in demonstration projects is of great importance and to be considered indispensable. This co-operation has not only substantially developed further the state of knowledge on clay stone and crystalline rock but also helped create the basis for assessing non-saline host rock types in Germany. On top of that, thanks to these research activities it has been possible to build up and expand considerable knowledge in German organisations, allowing well-founded evaluations and assessments of repository concepts in all host rock types. This has contributed to the fact that the political call for an analysis and assessment of all relevant host rock types in Germany could be followed.

Co-operation takes place predominantly with organisations from other European countries and – at varying intensity – with the United States of America, the Russian Federation, and China.

Within the framework of the international co-operation activities, projects with German participation are carried out nationally as well as in connection with the 7th EU research framework programme. A continuation of the international research activities is also intended for the new Horizon 2020 research framework programme of the EU. Within the framework of the co-operation with the OECD-NEA, activities include work in the Integration Group for the Safety Case (IGSC) as well as in the Salt Club and the Clay Club.

The financial means available to the authorities for their own personnel and for the consultation of experts are fixed by the Bundestag (Federal Parliament) in the respective budgets. In this context the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) awards contracts of relevant R&D work in conjunction with regulatory issues to technical support organisations such as the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS). The GRS is the central scientific and technical expert organisation advising the federal government in the field of nuclear safety and radiation protection. GRS performs scientific research in these areas, including radioactive waste management and disposal, predominantly under federal contracts and supports the BMUB in technical issues.

As subordinate authority of the BMUB, the Federal Office for Radiation Protection (BfS) performs implementation tasks of the Federation in accordance with the Atomic Energy Act

and the Radiation Protection Ordinance fulfilling tasks in the fields of radiation protection, nuclear safety, the transport of radioactive material and the disposal of radioactive waste. The BfS supports the BMUB technically and by scientific research in its responsibility, among others, regarding the disposal of radioactive waste. The BfS co-operates with universities and non-university institutions in Germany and abroad. This scientific co-operation include working together in general terms (i.e. general arrangements with scientific organisations or universities stipulating basic parameters such as financial expenditures, staff assignment/exchange, as well as co-operation in education), carrying out joint projects (i.e. research and development cooperation related to specific topics), and sharing research infrastructure.

DECOMMISSIONING AND DISMANTLING POLICIES AND PROJECTS

Following the end of their operational use, nuclear facilities and installations (referred to in the following as installations) are to be dismantled and released from nuclear supervision. The aim is to re-establish the original condition of the so-called "greenfield" or to continue using the installations for conventional purposes.

The dismantling of all nuclear power plants as well as of other installations taken out of operation during the period under consideration is to be executed, subject to an available disposal facility, in due time so that the negligible heat-generating radioactive waste generated during this process can be emplaced in the Konrad disposal facility. By the timely commissioning of the Konrad disposal facility, the addition of further storage capacities after the commissioning of this disposal facility is to be avoided if possible, and this way the dismantling of the nuclear power plants is to be brought to a conclusion as soon as possible.

The plant operator has to present his chosen dismantling concept to the competent authority as part of his application for decommissioning. On the basis of the experience so far, the entire dismantling of a nuclear power plants is estimated to take on average a period of around 20 years per reactor unit. For each nuclear power plant, an average waste packet volume of around 5,000 m³ of radioactive waste with negligible heat generation is expected.

As most dismantling projects follow the strategy of direct dismantling, it is assumed that all nuclear power plants will have been dismantled approximately by the year 2045. The radioactive waste with negligible heat generation generated during dismantling can thus be delivered to the Konrad disposal facility during its operating period.

The few plants that are currently still in safe enclosure (Hamm-Uentrop Thorium High-Temperature Reactor, Research Reactor 2 (FR 2, Karlsruhe), Research Reactor Neuherberg) are to be dismantled in due time so that the radioactive waste with negligible heat generation generated can also be emplaced in the Konrad disposal facility during its operating period.

TRANSPORT

The safety regulations for the transport of radioactive waste are prescribed by the Atomic Energy Act, the Radiation Protection Ordinance, and the regulations on the transportation of dangerous goods, primarily the Dangerous Goods Ordinances concerning Road and Rail Transport, as well as international regulations for the safe transport of radioactive materials

(SSR 6, ADR, RID, AND etc.). It distinguishes between "nuclear fuels" and "other radioactive materials". A transport license must be obtained from the Federal Office for Radiation Protection for the transport of nuclear fuels and large radioactive sources. Large radioactive sources have an activity of more than 1,000 TBq and include, for example, cobalt-60 radiation sources which are used in the medical field. Transports of other radioactive materials, e.g. transports of radio-pharmaceutical products, are granted by the competent federal state authorities on behalf of the federal government for transports on roads and inland waterways as well as with not federally owned trains in train and shipping traffic. Transports with federally owned trains in train and shipping traffic are granted by the Federal Railway Authority. The Federal State (Länder) Authorities, the Federal Railway Authority and the Federal Air Transport Authority are responsible for supervising transport operations.

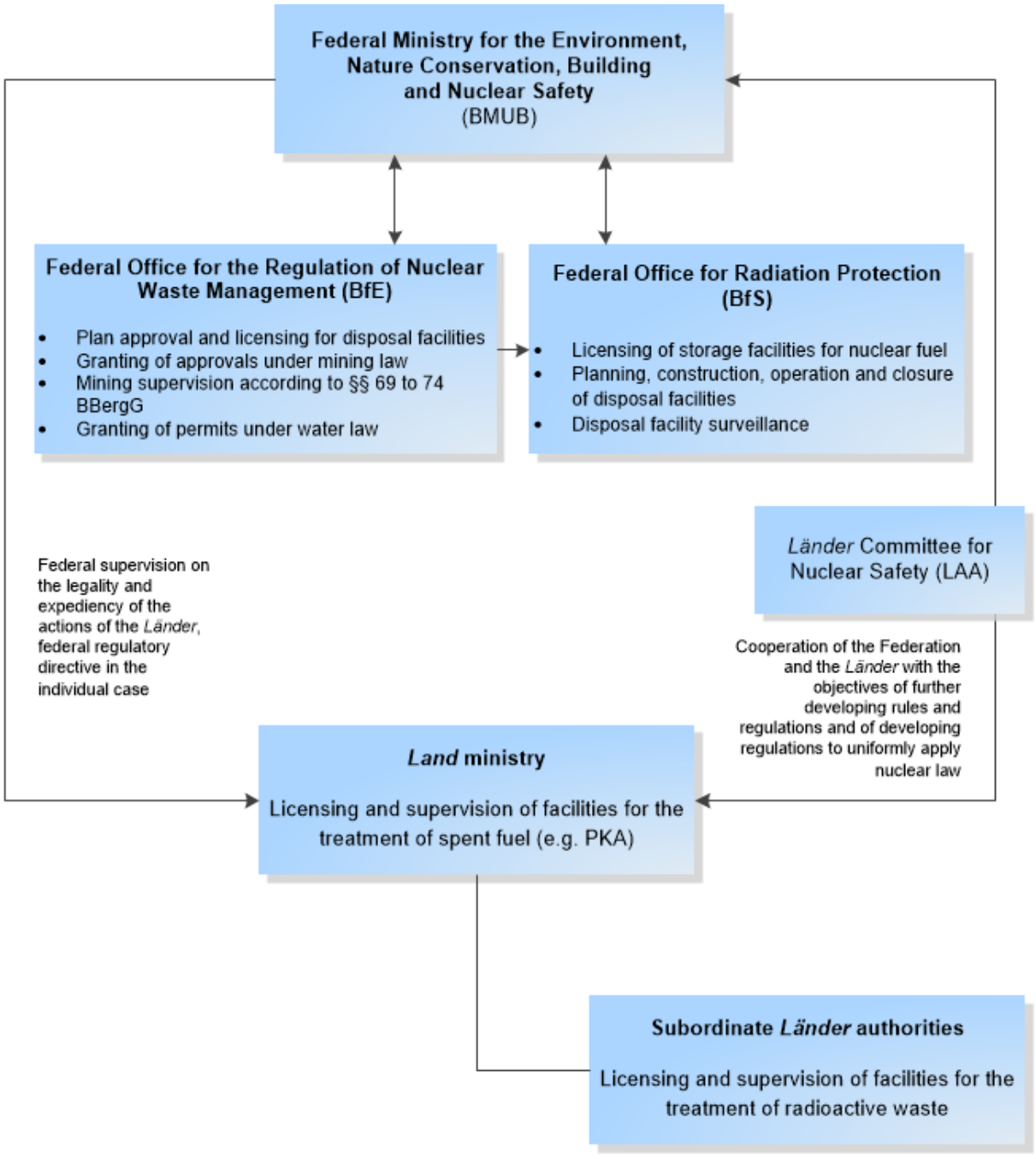
COMPETENT AUTHORITIES

In order to protect against the hazards emanating from radioactive material and to control the use of this material, the Atomic Energy Act, as well as the Radiation Protection Ordinance in certain areas, require that the construction, operation and decommissioning of nuclear facilities and installations and the handling of radioactive material are subject to licensing (licensing includes in the German context licensing and plan approval procedures).

For waste processing (i.e. for pretreatment, treatment and conditioning), storage and disposal, the obligation to hold a licence for the handling of radioactive material in nuclear facilities is defined in different provisions of the regulatory framework. For the licensing and supervision of the various types of handling, different authorities may be responsible (see Figure 4) (see Chapter C.2.1[4] for details on the responsibilities relating to licensing).

[4] In First report on the implementation of Directive 2011/70/EURATOM, available online as supplementary material for the National Programme

Fig. 4 Organisational framework of the regulatory authority in the Federal Republic of Germany in the field of spent fuel and radioactive waste management after entry into force of the provisions of the Site Selection Act



In the Federal Republic of Germany, the construction, operation and closure of disposal facilities for radioactive waste are a federal task. The current allocation is regulated as follows:

- As the operator, the Federal Office for Radiation Protection (BfS) is responsible for the construction, operation and closure of disposal facilities as well as for the Asse II mine and employs in this connection the services of the German service company for the construction and operation of waste repositories (Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH, DBE mbH) and the Asse GmbH as so-called administrative aid. Moreover, the Federal Office for Radiation Protection is

project implementer in the site selection procedure for the planned disposal facility especially for heat-generating radioactive waste.

- The Federal Office for the Regulation of Nuclear Waste Management (BfE), established in 2014, is responsible for the licensing of a disposal facility especially for heat-generating radioactive waste based on the selection procedure according to the "Act on the search for and selection of a site for a repository for heat-generating radioactive waste and for the amendment of other laws (*Standortauswahlgesetz* – StandAG)" (Site Selection Act) /StandAG 2013/. The Federal Office for the Regulation of Nuclear Waste Management will become the competent licensing (plan approval) authority for the Konrad repository after its commissioning and for the Morsleben repository for radioactive waste after licensing (plan approval) for closure; these responsibilities currently lie with the Land of Lower Saxony for the Konrad repository and with the *Land* of Saxony-Anhalt for the Morsleben repository for radioactive waste.
- For the Asse II mine, the supreme *Land* authority of Lower Saxony remains to be responsible as licensing authority.
- The regulatory supervision (legal and technical supervision) of the Federal Office for Radiation Protection and the Federal Office for the Regulation of Nuclear Waste Management is exercised by the Federal Ministry for the Environment to whose area of responsibility these authorities belong.

FINANCING

This section reports on the financing of decommissioning and disposal as it is regulated as of March 2016. The situation may be subject to change depending on the report of the Commission for the Review of the Funding of the Phase-out of Nuclear Energy (Kommission zur Überprüfung der Finanzierung des Kernenergieausstiegs, KFK) to the Federal Government, which is expected to be published by end of April 2016.

The plant operators are responsible for the decommissioning of nuclear facilities. The power utilities operating nuclear power plants as well as the producers of radioactive waste in the area of the public sector, primarily companies receiving government financing, and private operators of other nuclear installations are obligated as waste producers to bear all costs of the decommissioning (including dismantling) of their nuclear facilities and installations as well as of the disposal of the radioactive waste.

According to § 9a para. 3 of the Atomic Energy Act (AtG), the Länder have to establish Land collecting facilities for the storage of the radioactive waste generated on their territory. The waste producers are obligated to deliver radioactive waste to the corresponding facilities. According to §§ 21 ff. AtG, they have to bear the cost in line with the polluter-pays principle.

The costs of the individual steps of dismantling as well as of the conditioning, storage and disposal of spent fuel, waste from reprocessing and other radioactive waste are compiled in the *Report on the Cost and Funding of the Management of Spent Fuel and Radioactive Waste*[5].

[5] Available online as supplementary material for the National Programme

Costs to be borne by the public sector and their funding

In the area of the public sector, there are twelve operators that are responsible for the dismantling of their facilities as well as for the conditioning and storage of their waste until the latter is delivered to a federal disposal facility. Moreover, there are eleven Land collecting facilities that are responsible for the conditioning and storage of the waste submitted to them until the latter is delivered to a federal disposal facility.

The funding of the decommissioning and waste management of the nuclear facilities and installations in the area of the public sector, primarily companies receiving government financing, is ensured by the federal republic and the Länder from public budgets. This also applies to the cost of disposal. Generally, the federal share of the cost is about 90% and the corresponding share of the Länder 10%. There are exceptions in this respect for the "Arbeitsgemeinschaft Versuchsreaktor GmbH (AVR)", where the federal share is 70%, for the "Technische Universität München (TUM)" and for VKTA - Radiation Protection, Analytic & Disposal Inc. (VKTA-Strahlenschutz, Analytik & Entsorgung Rossendorf e. V.), which are 100%-financed from the budget of the respective Land, the Lubmin and Rheinsberg sites of the Energiewerke Nord GmbH, which in accordance with the German Unification Treaty are 100%-financed from the federal budget, as well as the Institute for Transuranium Elements (ITU), which is 100%-financed from EU funds.

The Land collecting facilities charge fees from the waste producers for accepting radioactive waste. With this acceptance, the ownership of the waste is transferred to the respective collecting facility. From the fees thus collected, the Land collecting facilities pay over to the federal government a portion of the cost of later disposal. In accordance with § 21a (2), second sentence of the Atomic Energy Act, the Land collecting facilities must charge cost-covering fees (cost-covering principle).

The Thorium High-Temperature Reactor (THTR-300) is also a special case; for historical reasons, special arrangements for the funding of the orderly settlement of the project were made between the federation, the Land of North Rhine-Westphalia, the operating company "Hochtemperatur-Kernkraftwerk GmbH (HKG)" and its shareholders.

Incidentally, in terms of commercial law and in terms of tax law (for example, to classify as a liability in their balances of accounts provisions for nuclear asset retirement in adequate amounts), the same obligations that apply to private operators (see 2.2) also apply to companies under private law that receive government financing.

Costs to be borne by the private operators and their funding

The essential cost-relevant substeps of the decommissioning and waste management of nuclear facilities that have to be funded by the private companies, such as the power utilities operating the nuclear power plants, and by the nuclear fuel cycle industry, comprise the dismantling of the nuclear facilities as well as the management of spent fuel and radioactive waste including its disposal.

The private operators are obligated in terms of commercial law (especially § 249 German Commercial Code) and in terms of tax law to classify as a liability in their balances of accounts provisions for nuclear asset retirement in adequate amounts, i.e. for ensuring the financing in the future of the above-mentioned nuclear liabilities in connection with the decommissioning of the nuclear power plants and the management of their radioactive waste.

Costs of the disposal facilities

The cost of the planning, exploration, construction, the emplacement operation and the decommissioning of the Konrad disposal facility is distributed among the waste producers.

The cost of the closure of the Morsleben disposal facility as well as the cost of retrieving the radioactive waste from and closure of the Asse II mine is borne by the federation.

The cost of the search for and selection of a disposal facility especially for heat-generating radioactive waste and for the licensing, construction, operation and closure of such a disposal facility as well as the cost of operation to keep the Gorleben exploration mine open is distributed among the waste producers as stipulated by the Site Selection Act.

PUBLIC INFORMATION

In addition to the information available locally from individual companies and facilities, information has also been provided by federal government agencies, federal authorities, individual *Länder* governments and their agencies, and by the industry.

For more information, the websites of some relevant authorities and organisations are listed below.

Special Topics

National Programme for the responsible and safe management of spent fuel and radioactive waste and supplementary material (esp. First report on the implementation of Directive 2011/70/EURATOM)

Website: www.bmub.bund.de/en/topics/nuclear-safety-radiological-protection/nuclear-safety/sicherheit-endlager/national-programme/

Government

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)

Press and Information, Stresemannstraße 128 – 130, D-10117 Berlin

E-mail: presse@bmub.bund.de

Website: www.bmub.bund.de/en/

Federal Office for the Regulation of Nuclear Waste Management (BfE)
D-11055 Berlin

Website: http://www.bfe.bund.de/en/

Federal Office for Radiation Protection (BfS)
Willy-Brandt-Straße 5, D-38226 Salzgitter

E-mail: ePost@bfs.de

Website: www.bfs.de/EN/home/home_node.html

Legislation

Commission on Storage of High-Level Radioactive Waste
Deutscher Bundestag, Platz der Republik 1, D-11011 Berlin

E-mail: kommission.endlagerung@bundestag.de

Website (in German): www.bundestag.de/endlager/

Industry

GNS Gesellschaft für Nuklear-Service mbH
Frohnhauser Str. 67, D-45127 Essen

E-mail: info@gns.de

Website: www.gns.de/language=en/24394