Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety

ENVIRONMENTAL POLICY

JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

IT'S OUR FUTURE.

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 First Review Meeting in November 2003

5 May 2003

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List of Abbreviations

BAFA	*Bundesamt für Wirtschaft und Ausfuhrkontrolle* (Federal Office for Economy and Export Control)
BfS	*Bundesamt für Strahlenschutz* (Federal Office for Radiation Protection)
BGBl.	*Bundesgesetzblatt* (Federal Law Gazette)
BMBF	*Bundesministerium für Bildung und Forschung* (Federal Ministry of Education, Science, Research and Technology)
BMU	*Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit* (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety)
BNFL	British Nuclear Fuels Ltd.
BWR	Boiling Water Reactor
CEA	Commissariat à l'Energie Atomique (Paris)
COGEMA	Compagnie Générale des Matières Nucléaires
DBE	*Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH* (German Service Company for the Construction and Operation of Waste Repositories)
GDR	German Democratic Republic
DESY	*Deutsches Elektronen-Synchrotron*
DIN	*Deutsches Institut für Normung e. V.* (German Institute for Standardisation)
EAN	European Article Numbering
EBA	Eisenbahn-Bundesamt (Federal Office for Railways)
EIA	Environmental Impact Assessment
ERAM	*Endlager für radioaktive Abfälle Morsleben* (Repository for Radioactive Waste Morsleben)
EURATOM	European Atomic Energy Community
EUROCHEMIC	European Company for the Chemical Processing of Irradiated Fuels
EU	European Union
EVU	*Energieversorgungsunternehmen* (Electric Power Utility)
FZJ	*Forschungszentrum Jülich GmbH* (Research Centre Jülich GmbH)
FZK	*Forschungszentrum Karlsruhe GmbH* (Research Centre Karlsruhe GmbH)
GKSS	*Forschungszentrum Geesthacht GmbH (formerly: Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt mbH)* (Research Centre Geesthacht GmbH)
GNS	*Gesellschaft für Nuklear-Service mbH*
GSI	*Gesellschaft für Schwerionenforschung mbH*
GSF	*Forschungszentrum für Umwelt und Gesundheit GmbH (formerly: Gesellschaft für Strahlenforschung)* (Research Centre for Environment and Health)
HAW	High Active Waste
HAWC	High Active Waste Concentrate

HEU	Highly Enriched Uranium
HGF	*Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren*
HMI	*Hahn-Meitner-Institut für Kernforschung*
HTR	High Temperature Reactor
IAEA/*IAEO*	International Atomic Energy Agency/*Internationale Atomenergie Organisation*
ICRP	International Commission on Radiological Protection
IEC	International Electrotechnical Commission
IMIS	*Integrierte Mess- und Informationssystem zur Überwachung der Umweltradioaktivität* (Integrated Measurement and Information System for Monitoring Environmental Radioactivity)
INES	International Nuclear Event Scale
ISO	International Organization for Standardization
ITU	*Europäisches Institut für Transurane* (European Institute for Transuranic Elements)
KFA	*Kernforschungsanlage Jülich* (now FZJ)
KfK	*Kernforschungszentrum Karlsruhe* (now FZK)
KTA	*Kerntechnischer Ausschuss* (Nuclear Safety Standards Commission)
KWU	*Kraftwerk Union AG*
LAA	*Länderausschuß für Atomkernenergie* (Länder (Federal States) Committee on Nuclear Power)
LAFAB	*Länderausschuß für Atomkernenergie – Fachausschuß Brennstoffkreislauf* (Länder (Federal States) Committee on Nuclear Power – Specialised Fuel Cycle Committee)
LBA	*Luftfahrtbundesamt* (Federal Civil Aviation Authority)
LAW	Low Active Waste
LWR	Light Water Reactor
MAW	Medium Active Waste
NEA	Nuclear Energy Agency
NORM	Naturally Occurring Radioactive Material
NPP	Nuclear Power Plant
OECD	Organisation for Economic Co-operation and Development
OJ EC	Official Journal of the European Communities
PAE	*Projektgruppe Andere Entsorgungstechniken des Forschungszentrum Karlsruhe* (Project Group for Alternative Waste Management Techniques, Karlsruhe Research Centre)
PWR	Pressurized water reactor
RSK	*Reaktorsicherheitskommission* (Reactor Safety Commission)
SKB	Svensk Kärnbränslehantering AB (Swedish Nuclear Fuel and Waste Management Co)
SSK	*Strahlenschutzkommission* (Commission on Radiological Protection)
TBL	*Transportbehälterlager* (Transport Cask Storage Facility)
TENORM	Technologically-Enhanced Naturally Occurring Radioactive Material
UKAEA	United Kingdom Atomic Energy Agency
VKTA	*Verein für Kernverfahrenstechnik und Analytik Rossendorf e. V.*
WWER	Water Cooled and Water Moderated Energy Reactor (Soviet design)

Section A. Introduction

(1) Structure and Content of the Report

The Federal Government will continue to meet Germany's existing international obligations, particularly with regard to fulfilment of the Joint Convention. In submitting this report, the Federal Republic of Germany is demonstrating its compliance with the Joint Convention and ensuring the safe operation of facilities for the management of spent fuel and radioactive waste, including the decommissioning of nuclear installations. At the same time, there is still a need for future action in order to maintain the required high standards of safety and ensure disposal.

The report to the Joint Convention closely follows the guidelines regarding the form and structure of national reports. As such, it is divided into sections which address the individual articles of the Convention as prescribed in the guidelines. An introduction considering the historical and political development of nuclear power use is followed by a separate commentary on each individual obligation. As suggested in the Guidelines Regarding National Reports, statements made in the report tend to be of a generic nature, although plant-specific details are given wherever necessary in order to illustrate compliance with the requirements of the Convention.

In order to demonstrate compliance with the obligations, explanatory comments are given on the pertinent national laws, ordinances and standards, and descriptions are provided of the manner in which essential safety requirements are met. In the current national report, special emphasis is placed on describing the licensing procedure and state supervision, as well as the measures applied by the operators at their own responsibility for maintaining an appropriate standard of safety.

The report contains a list of nuclear facilities currently in operation as defined by this Convention, including an overview of the safety-relevant design characteristics of those facilities, classified according to their management of spent fuel or radioactive waste, together with a list of decommissioned and dismantled facilities, plus a comprehensive list of the legal and administrative provisions, statutory regulations and guidelines in the field of nuclear power which are relevant to the safety of the facilities as defined by this Convention and which are referred to in this report.

(2) Historical Development

In the Federal Republic of Germany, research and development into the civil use of nuclear energy began in 1955 after the Federal Republic of Germany had officially renounced the development and possession of nuclear weapons. The research and development programme was based on intensive international co-operation and included the construction of several prototype reactors, as well as the elaboration of concepts for a closed nuclear fuel cycle and for the final storage of radioactive waste in deep geological formations.

In 1955, the Federal Government established the Federal Ministry for Nuclear Affairs and Germany became a founder member of the European Atomic Energy Community (EURATOM) and the Nuclear Energy Agency (NEA) of the OECD. With the aid of US manufacturers, German power plant manufacturers began to develop commercial nuclear power plants (Siemens/Westinghouse for PWR, AEG/General Electric for BWR).

In subsequent years, the following nuclear research centres were founded in West Germany:

1956 in Karlsruhe (Kernforschungszentrum Karlsruhe KfK),

in Geesthacht (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt GKSS) and

in Jülich (Kernforschungsanlage Jülich KFA);

1959 in Berlin (Hahn-Meitner-Institut für Kernforschung HMI) and

in Hamburg (Deutsches Elektronen-Synchrotron DESY);

1969 in Darmstadt (Gesellschaft für Schwerionenforschung GSI).

Many universities were equipped with research reactors. The FRM research reactor in Garching commenced operation in 1958.

In 1957, the first German nuclear power plant, the 15 MWe experimental nuclear power plant (VAK) in Kahl, was ordered from General Electric and AEG, and became operational in 1960. Between 1965 and 1970, this was followed by further orders for power reactors with 250-350 MWe and 600-700 MWe respectively.

In the years that followed, larger power reactors (PWR and BWR) were built by the company Kraftwerk Union (KWU) with a capacity of 1300 MWe, the last of which commenced operation in 1988. Power plants of this kind were also exported abroad. Since then, nuclear energy has accounted for just over 30 % of electricity production in Germany.

Reactors with a lower output from the early years of nuclear power use have since been switched off, and are in varying stages of decommissioning. Two of them have been dismantled and the land recultivated. Two larger power reactors have likewise been deactivated (Würgassen is currently in the process of dismantling, whilst in the case of Mülheim-Kärlich, decommissioning has been applied for). Details can be found in Table L–11.

In the 1950s, West Germany likewise began to independently develop reactors, with close collaboration between the nuclear research centres and industry. This led to the construction of a number of experimental reactors. Worth mentioning in this connection are the order placed in 1958 with BBK/BBC for the experimental 15 MWe *Arbeitsgemeinschaft Versuchsreaktor* (AVR) high-temperature pebble-bed reactor at the Jülich Nuclear Research Centre, and the order placed in 1961 with Siemens for the 52 MW multi-purpose research reactor (MZFR), a heavy water PWR. In the late Sixties, development work began on a fast breeder at the Karlsruhe Nuclear Research Centre. This was later followed by the construction of two prototypes, a high-temperature pebble-bed reactor on the basis of thorium (Thorium High Temperature Reactor – THTR-300) and a fast breeder (SNR-300), each with a capacity of 300 MWe. The THTR was shut down after six years of operation (1983-1989) and is currently securely encapsulated, whilst the SNR was completed but never loaded with fuel elements. The fuel elements of the SNR are in government custody.

The former German Democratic Republic (GDR) also began to develop a nuclear programme for the peaceful use of nuclear energy in 1955, and was supported by the Soviet Union. In 1956, the Central Institute for Nuclear Research (ZfK) was founded in Rossendorf near Dresden, where a research reactor supplied by the Soviet Union started operation in 1957. The first commercial reactor – a 70-MWe pressurised water reactor of Soviet design – was built in Rheinsberg and reached criticality in 1966. Between 1973 and 1989, five pressurised water reactors, four of the Soviet type WWER-440/230 and one of type WWER-440/W-213, started operation in Greifswald.

During the course of German reunification, all six of these reactors have been shut down and are now in the process of decommissioning. At the same time, the construction of five further WWER reactors at Greifswald and Stendal was discontinued.

In total, therefore, some 17 nuclear power plants in Germany are currently in the process of decommissioning or have been dismantled, or else decommissioning has been applied for (cf. Table L–11 in the Annex). The 19 power units still in operation are due to be decommissioned gradually over the next twenty years as agreed between the federal government and the utilities [BUN 00].

The Federal Republic of Germany has also acquired experience in the field of plutonium recycling in light-water reactors via the use of mixed oxide (MOX) fuel elements. Approval has been granted by the competent authorities of the *Länder* (Federal states) for the use of MOX fuel elements in ten pressurised water reactors. The individually licensed deployable amounts range from 9 % to 50 % of the total core inventory. In the case of boiling water reactors, licences have been issued to deploy up to 38 % of the core inventory for the two units at Gundremmingen (units B and C). Further licences have been applied for. To date, MOX fuel elements have been deployed up to 33 % of the core inventory in the case of pressurised water reactors, and up to 24 % in the case of boiling water reactors.

Regarding the commercial use of nuclear power in Germany, in addition to power reactors, other nuclear facilities also began to emerge which were designed to ensure the fuel cycle and the safe disposal of all waste resulting from this use.

In the Seventies, the German utility companies formulated plans to build a centre where all activities connected with the fuel cycle and waste management would be concentrated on one site, the so called “integrated disposal centre” (*Entsorgungszentrum*). This disposal centre, consisting of a reprocessing plant, fuel fabrication plants for uranium and MOX fuel rods, waste management facilities for all types of waste and a repository for all this waste, was to be constructed at the site of Gorleben in Lower Saxony. Plans for the centre, with the exception of the repository project, were later shelved in 1979 following political intervention by the state government of Lower Saxony, whereupon the utilities turned instead to plans for a scaled-down project which would be confined to reprocessing and MOX-fuel fabrication at the site of Wackersdorf in Bavaria. In 1989, the utilities subsequently resolved to abandon this project, and the on-going licensing procedure was cancelled. From then onwards, the utilities turned their attention instead to reprocessing abroad.

Various nuclear facilities dedicated to the fuel cycle and waste management have nevertheless been built. In the past, facilities for the fabrication of U, HTR and MOX fuel elements were operated at the Hanau site; however, these have since all been closed and are currently in the process of decommissioning. A new MOX facility was built to replace the old one at this site but was never commissioned. One uranium-enrichment plant at Gronau and one fuel fabrication plant at Lingen remain operational.

The pilot reprocessing plant at Karlsruhe (WAK) was decommissioned in 1990 and is in the process of being dismantled. There are plans to vitrify the highly radioactive solutions of fission products still remaining at this plant in order to prepare them for disposal. A plant is currently under construction for this purpose. A number of facilities are currently operational for the interim storage of spent fuels as well as the treatment, conditioning and interim storage of radioactive waste. The licensing procedure for the pilot conditioning plant (PKA) in Gorleben, which was designed for the conditioning of spent fuel for direct disposal, was completed in December 2000 with the granting of the third partial construction licence; however, the licence restricts use of the facility to the repair of defective casks for spent fuel elements.

Development work in the field of repositories began with the installation of the ASSE research mine in a salt dome, where low- and medium-level radioactive waste was disposed of on an experimental basis until the end of 1978. In the former GDR, the Morsleben repository was available for the disposal of low and medium-level radioactive waste; following reunification, this repository was used for the emplacement of low- and medium-level radioactive waste from all over Germany up until September 1998.

In 1982, an application was submitted to store non-heat generating waste at “Shaft Konrad”, a former ore mine. A licence to this effect was granted in May 2002. Exploration works in the salt dome at the site of Gorleben commenced in 1986, aimed at establishing whether this salt dome is suitable for the disposal of radioactive waste, including high-level waste. The underground exploration works in the Gorleben mine were interrupted in the year 2000 for a minimum of 3 years, and a maximum of 10 years.

(3) Political Development

Following the euphoria of the Fifties and Sixties, scepticism towards nuclear power began to grow in Germany. Increasing numbers of citizens became opposed to the risks of atomic energy, and in particular the further expansion of nuclear power plants. Names such as Wyhl/Brokdorf (nuclear power plants), Gorleben (waste management centre), Wackersdorf (reprocessing) and Kalkar (fast breeder) have become synonymous with this protest movement. By the time of the accident in Harrisburg in 1979 and finally the Chernobyl disaster in 1986, it had become clear that the risks of nuclear power are not merely theoretical. These events strengthened opposition to the use of nuclear power; and with no further major projects in the pipeline, resistance was directed instead primarily against the transportation of nuclear materials, and particularly the interim storage facilities at Ahaus and Gorleben.

Mindful of the fact that both human life and public health are protected under the German constitution, during the 14th legislative period in Germany (1998-2002) there has been a re-evaluation of the risks of nuclear power use. Based on recent findings and experiences, the outcome of this process has prompted a decision by the Federal Republic of Germany to phase out the use of nuclear energy for commercial electricity production in a carefully coordinated process. The agreement of 14 June 2000 between the German government and the utilities to phase out the use of nuclear power (ratified on 11 June 2001) therefore limits the standard lifetime of nuclear power plants to 32 years from the date of commissioning. This agreement was translated into national law with the entry into force of the Act on the Structured Phase-out of the Utilisation of Nuclear Energy for the Commercial Generation of Electricity [1A-2]. This Act also aims to limit the occurrence of radioactive waste.

The Federal Republic of Germany believes that the residual risk resulting from the commercial use of nuclear energy for electricity production, which previous governments had deemed socially adequate, is only acceptable for a limited period, given the possible extent of the damage in case of an accident. It furthermore believes that the risks of disposal and reprocessing of irradiated fuel elements, as well as the potential misuse of nuclear fuel, necessitate a definite end to the commercial use of nuclear energy in the near future. This resolution is supported by a broad majority of the population.

At the time, the decision in favour of the peaceful use of nuclear energy, as stipulated in the Atomic Energy Act (AtG) [1A-3] of 1959, was based on a careful weighing of the advantages versus the risks to human life and health. The Federal Republic of Germany now feels that it is necessary to phase out the use of nuclear power based on a re-evaluation of the justifiability of the risks and on worldwide experience to date of nuclear power plant operation, radioactive waste management and the misuse of nuclear fuel since nuclear power was first used to generate electricity. At the same time, these decisions will also put an end to a deep-seated conflict within society. The Federal Republic of Germany feels that the existing risks, which were previously tolerated as socially adequate residual risks, are only tolerable for a limited period of time, insofar as it is capable of influencing them within its legislative powers. These risks, it is felt, can only be eliminated by discontinuing the use of nuclear power for the commercial generation of electricity in German plants. Consequently, the decision to promote nuclear power – as laid down in the Atomic Energy Act of 1959 – is no longer supported.

Even though the Atomic Energy Act stipulates that precautions must be taken against possible damage in accordance with the best available technology, and that on this basis, nuclear facilities in Germany are assured of a high level of protection compared with other countries, international experience has shown – as demonstrated most visibly by the Chernobyl accident – that accidents with major releases of radioactive material are more than a theoretical possibility. Moreover, the experience gleaned since the use of nuclear energy first began has shown that new, previously unsuspected risks are constantly emerging. Even the many safety improvements which have been made to nuclear facilities over the years cannot alter the substance of this realisation.

Furthermore, the Federal Republic of Germany estimates the radiation risk, as determined on the basis of the results of a re-evaluation of empirical data by the International Radiation Protection Commission, to be higher than was originally presumed at the time of the licensing of the German nuclear facilities in accordance with the Atomic Energy Act of 1959. Allowance was made for these re-evaluations in the 2001 amendment to the Radiation Protection Ordinance.

Another reason for phasing out nuclear power, in the eyes of the Federal Republic of Germany, lies in the largely unresolved issue of the disposal of radioactive waste. The protection of life, physical integrity, public health and of the natural resources needed to sustain life demands that radioactive waste must be stored safely in perpetuity in such a way that it is separated from the biosphere. At present, no country in the world has come up with a practical solution to the problem of final storage of high-level radioactive waste. Today’s radioactive waste may burden future generations. With this in mind, the phase-out of nuclear power also aims to at least limit the production of further radioactive waste from facilities dedicated to the commercial use of nuclear power.

In the opinion of the Federal Republic of Germany, the use of nuclear energy also fails to meet the requirements of a sustainable energy supply as stipulated in AGENDA 21 [AGE 92], which calls for an energy supply which is not generated at the expense of future generations.

With the agreement of 14 June 2000 [BUN 00] between the Federal Government and the power utilities (ratified on 11 June 2001), in spite of the prevailing differences of opinion on the use of nuclear power, the German power industry has demonstrated that it respects the Federal Government’s decision to phase out the production of electricity from nuclear energy in a carefully coordinated process and to work towards implementation of the new energy policy. The key points of this agreement relevant to the scope of this Convention are as follows:

- Reprocessing will be discontinued and replaced by the direct disposal of spent fuel elements.
- The delivery of irradiated fuel elements to La Hague and Sellafield for reprocessing will be terminated by the middle of 2005. Thanks to this move, and by setting up local interim storage facilities at the sites of the German nuclear power plants for the remaining spent fuel elements generated up until the time of decommissioning, the number of nuclear transports will considerably be reduced. In future, by storing the spent fuel elements at interim storage facilities on the plant site and only transporting them to a repository once interim storage is complete, this number will be reduced by up to two-thirds.

- The licensing procedure for a pilot facility for the conditioning of spent fuels currently under construction will be completed, but the use of the facility will be restricted to the repair of defective casks.
- The exploration of the Gorleben salt dome as a repository will be interrupted to allow sufficient time in order to clarify conceptual and safety-related issues during the moratorium period of up to 10 years. Until that date, the site will be preserved and made safe in its current state.
- The plan approval procedure for the Konrad repository will be completed. Operation cannot commence until the court has reached a decision on the objections filed.

The agreement initialled on 14 June 2000 was signed by the Federal Government and the power utilities EnBW, E.ON, HEW and RWE on 11 June 2001. Although the agreement is not legally binding, it contains a series of agreed measures which fall within the scope of this Convention and which are currently being implemented, or will be implemented in future, by the parties concerned. As per the end of 2002, the latest state of play was as follows:

- The most important measure was the amendment to the Atomic Energy Act, implementing key elements of the agreement. These are reflected in the current version of the Atomic Energy Act following the most recent amendment of 19 July 2002 [1A-3].
- A precondition for reprocessing is that proof must be submitted of the harmless utilisation of separated nuclear fuel and returned reprocessing waste. Requirements governing the form and content of this proof of utilisation are specified by a new provision in the aforementioned amendment to the Atomic Energy Act.
- The Federal Office for Radiation Protection ensures that the licensing procedures for the interim storage of spent fuel elements at the sites of nuclear power plants currently in operation are carried out expeditiously. The same applies to additional licensing procedures for interim storage facilities at selected sites, an interim solution designed to avoid transportation until such time as the local interim storage facilities are ready to use.
- The licensing procedure for the pilot conditioning plant is complete. The licence was granted in December 2000.
- The moratorium period for the Gorleben salt dome commenced on 1 October 2000. The Federal Government will use this interruption to clarify conceptual and safety-related issues concerning final storage.
- The plan approval procedure for the Konrad repository was completed and a resolution adopted on 22 May 2002. However, the decision is not yet legally valid since objections have been filed.

It is essential to ensure the safe operation of the nuclear power plants during the remainder of their operating lives, as well as that of facilities for the processing of spent fuel elements and radioactive waste. To this end, an efficient and well-informed supervisory system of nuclear installations is essential. In order to ensure that this remains the case, the competent government agencies in Germany will guarantee the necessary financial resources, the technical expertise of their personnel, the required level of human resources as well as an expedient and effective organisation. The regulatory authorities will take measures to ensure that this applies analogously to the operators of the facilities.

In the Federal Republic of Germany, the Basic Law (GG) [GG 49] sets forth the principles of a democratic social order, namely the government's responsibility to protect life and health and natural resources needed to sustain life, the separation of powers, the independence of licensing and supervisory authorities, and the supervision of administrative actions by independent courts.

The legislation, administrative authorities and jurisdiction created specifically for the peaceful use of nuclear energy provide the framework of a system which safeguards the protection of life, health and property of those directly employed by the industry, and the general public, from the hazards of nuclear energy and the damaging effects of ionising radiation, as well as ensuring the regulation and supervision of safety during the construction and operation of nuclear installations. In accordance with the statutory requirements in the field of nuclear technology, ensuring safety is the highest priority. By applying the best available technology as a key guiding principle, measures are taken to ensure that internationally accepted safety standards as specified, for example, in the ”Safety Fundamentals” of the IAEA [IAEA 95], [IAEA 96F] are taken into account. One principal objective of the German Federal Government’s safety policy in the field of nuclear energy was, and still is , that the operators of nuclear facilities should also develop a high safety culture within their own field of responsibility.

In the past, a technical and scientific environment was created in Germany with federal support, which in addition to enabling the production of electricity from nuclear energy also facilitated the associated nuclear fuel cycle and the preparations required for the disposal of radioactive waste. During the course of this process, a safety concept was developed for all the aforementioned nuclear facilities.

Section B. Policies and Practices

Article 32 (Reporting), Paragraph 1

Article 32

1. *In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention.*

The report contains information pertaining to the situation for the safe management of spent fuel elements in Germany. In Germany, the reprocessing of fuel elements would be classified under "management" within the meaning of this Convention. However, as Germany delivers its spent fuel elements to France and the United Kingdom for reprocessing, we will not be reporting here on the reprocessing of German fuel elements. There are no fuel elements used by the military sector in Germany, and hence there is also no need to report on this aspect.

The report also contains information regarding the situation for the safe management of radioactive waste in Germany in the scope of this Convention. NORM and TENORM wastes (refer to the comments on Article 3 2.) are excluded from reporting, as are wastes assigned to the military sector, since management of the latter does not fall within the scope of civil surveillance.

Article 26 deals exclusively with general issues of decommissioning. A report on the facilities currently in the process of decommissioning can be found primarily in the remarks on Article 32 2. (v).

Article 32 1.

For each Contracting Party the report shall also address its:

Article 32 1.

(i) spent fuel management policy;

Germany's policy on the management of spent fuel has undergone a number of changes. Until 1994, the Atomic Energy Act included the requirement of reusing the fissile material in the spent fuel elements. This requirement changed with the amendment of the Act in 1994, and the operators of nuclear power stations then had the option of either reuse by means of reprocessing, or else direct disposal.

As of 30 June 2005, delivery for the purposes of reprocessing will be prohibited in accordance with an amendment to the Atomic Energy Act (AtG) to this effect of 22 April 2002 [1A-2], and only direct disposal of the fuel elements then existing in Germany will be possible. Until that date, the quantities of spent fuel elements contractually agreed with the reprocessing facilities must have been taken to said facilities by the nuclear power plant operators.

For those spent fuel elements disposed of by way of reprocessing, proof of reuse must be kept of the recycled plutonium separated during reprocessing. This is designed to ensure that all plutonium in separated form can be precluded from misuse throughout the remaining residual terms.

As there is as yet no repository available for spent fuel elements, they will be stored intermediately at the site where they were created until such time as the repository is commissioned, in order to avoid the transportation of spent fuel and help spread the burden.

Usually, the spent fuel elements from research reactors will be returned to their country of origin for disposal. If that is not possible, these too will be intermediately stored until their final transportation to the repository.

The Federal Government is aiming to establish a repository in deep geological formations for the disposal of all kinds of waste by the year 2030. The moratorium period for Gorleben of 3 to 10 years does not mean that this site will be abandoned as a possible repository for spent nuclear fuel.

Article 32 1.

(ii) spent fuel management practices;

The spent nuclear fuel delivered to France and the United Kingdom until 30 June 2005 will be reprocessed. It is anticipated that the quantities agreed in the reprocessing contracts will have been delivered by that date. The operators of nuclear power plants are required to provide evidence of the safe reuse of all plutonium generated, generally by means of its reuse as MOX in the reactor, and the safe storage of all uranium.

All other types of fuel elements remaining in Germany, and those which will continue to be generated, will be stored in an interim storage facility until their final transportation into a repository. Statutory requirements stipulate that this should take place in interim storage facilities to be constructed at the sites of the nuclear power plants, which will be reserved solely for spent fuel arising at that particular site. The spent fuel is stored dry in casks. Spent fuel elements from decommissioned power reactors of Soviet design in the former GDR are likewise to be stored dry in casks at a central storage facility in Greifswald.

If, in exceptional cases, interim storage at the site of the nuclear power plants is not possible, there are two central storage facilities available at Ahaus and Gorleben which are operational and on stand-by.

Article 32 1.

(iii) radioactive waste management policy;

From the outset, Germany’s policy in the field of radioactive waste management has been directed at depositing all kinds of radioactive waste in deep geological formations. The Federal Government is required to provide the resources for disposal.

Additionally, it is a political requirement that all stages in the treatment of radioactive waste prior to its disposal are subject to the “polluter pays” principle.

In accordance with this principle, the state obligates the creators of waste by law to ensure the controlled and safe management of radioactive waste arising during the operation and decommissioning of nuclear facilities (such as nuclear power plants and research centres). As such, they operate facilities in which the radioactive waste incurred may be treated and stored until its disposal; this may take place either in decentralised or centralised facilities.

Furthermore, they are also responsible for the safe management of the radioactive waste resulting from the reprocessing of German spent fuel in France and the United Kingdom following its return, which Germany is under obligation to accept.

Where not stored by the producer, radioactive waste from research, industry and medicine may be deposited in State collecting facilities provided by the *Länder* (Federal states). The Federal Government is obliged to accept the waste from these storage facilities into the future repository if it can not be released once the radioactivity has decayed.

The Federal Government is aiming to establish a repository in deep geological formations by approximately 2030, which will be suitable for all of types and quantities of radioactive waste. In accordance with this objective, Germany does not practice the emplacement of radioactive waste into near surface repositories.

Article 32 1.

(iv) radioactive waste management practices;

Only stable (or fixed) radioactive waste will be accepted for disposal in deep geological formations; liquid and gaseous waste is excluded from acceptance. The controlled, safe disposal of radioactive waste therefore requires its conditioning and interim storage prior to entering the repository.

Conditioning comprises several stages, depending on the quality and nature of the raw waste. After targeted collection or grading (where necessary), the raw waste may first be pretreated and then either processed into interim products or directly into packages suitable for storage or disposal.

Proven methods and reliable mobile and stationary installations already exist for the pretreatment and conditioning of radioactive waste. Mobile conditioning installations are the preferred choice for the treatment and packaging of operational waste from nuclear power plants. Stationary installations which are capable of conditioning various different types of raw waste tend to be used primarily in the major research centres; there are also a number of other stationary conditioning installations which are operated on site by the respective polluters.

Apart from waste management at German facilities, facilities in other European foreign countries are also utilised. Radioactive waste arising from the operation of nuclear installations is delivered to Sweden for conditioning. Waste from the reprocessing of spent fuel from German power reactors is conditioned in France and the United Kingdom, then returned to Germany in accordance with the contractual arrangements.

Both centralised and decentralised storage facilities are available for the interim storage of radioactive waste with negligible heat generation from the nuclear industry. For waste arising from the use and handling of radioisotopes in research, industry and medicine (cf. explanatory comments on Article 32 1. (iii)), State collection facilities operated by the *Länder* (Federal States) are available for interim storage, whilst central storage facilities are available for heat generating radioactive waste. For spent fuel which is not reprocessed, there are plans in future to provide on-site interim storage facilities, the licensing of which is currently in progress. It is assumed that the spent fuel elements and the radioactive waste will be stored intermediately for up to 40 years.

Within the scope of product control, the compliance of the packages with the requirements set out in the acceptance criteria of the repository will be reviewed. At present, the acceptance criteria of the Konrad repository [BfS 95] are particularly decisive; non-site-dependent acceptance criteria are currently under development. The product control measures concern both existing conditioned radioactive waste, as well as waste due to be conditioned in the future. They are designed in such a way as to ensure reliable detection of any packages which fail to meet the specifications.

Between 1971 and 1998, low- and medium-level radioactive waste from nuclear facilities was emplaced at the Morsleben repository. This facility stopped accepting waste in 1998, and a concept is currently under development to fill and seal this repository. There are also two further repository projects, Konrad and Gorleben. An appeal has been launched against the plan approval notice for Gorleben issued in May 2002; meanwhile, the underground explorations at the Gorleben repository mine have been interrupted whilst the conceptual and safety related issues are clarified.

Article 32 1.

(v) criteria used to define and categorize radioactive waste.

Radioactive residues are produced during the operation of nuclear facilities and installations, as well during the decommissioning or dismantling of such facilities. These residues are composed of reusable or recyclable materials and radioactive waste. Radioactive waste refers to materials that cannot be safely reused and which must therefore be disposed of in a controlled way (cf. term definitions in section 2 of the Atomic Energy Act (AtG)and DIN 25401 [DIN 25401], regulations governing recycling and disposal in section 9a of the Atomic Energy Act, and section 29 of the Radiation Protection Ordinance (StrlSchV)). The aforementioned activities may also generate material which is only marginally contaminated or activated. Provided such material is proven to comply with the clearance levels stated in Annex III, Table 1 to Section 29 of the StrlSchV, it may be released and utilised, removed, owned or forwarded to third parties as non-radioactive materials (cf. the remarks on Article 24 2. (i) and (ii)).

The German repository concept is pivotal to the criteria used to define and categorize radioactive waste. In the Federal Republic of Germany, the intention is that all types of radioactive waste should be stored in deep geological formations. This applies to waste from reprocessing of spent fuel elements from German nuclear power plants at facilities in other European countries, as well as to waste from the operation and decommissioning and/or dismantling of commercially operated nuclear facilities, together with waste originating from the use of radioisotopes in research, trade, industry and medicine.

The intention to dispose of all types of radioactive waste in deep geological formations also makes it unnecessary to differentiate between waste containing radionuclides with comparatively short half-lives and waste containing radionuclides with comparatively long half-lives. As such, there are no measures or precautions required in order to separate the radioactive waste generated in this way.

The proper registration and description of waste is an essential pre-requisite of radioactive waste management. In accordance with the German approach to disposal, the definition and categorisation of radioactive waste (i.e. its classification) must therefore comply with the requirements for safety assessment of an underground repository. In this respect, the effects of heat generation from radioactive waste on the design and evaluation of a repository system are particularly important, since the natural temperature conditions may be significantly altered by the deposited waste. In order to meet the requirements concerning the registration and categorisation of radioactive waste from the point of view of disposal, the authorities have chosen to distance themselves from the terms LAW, MAW and HAW and opted instead for a new categorisation: Initially, waste is subjected to a basic subdivision into

- Heat-generating radioactive waste and

- Radioactive waste with negligible heat generation

followed by a detailed classification according to the categorisation scheme established for this purpose.

This basic subdivision into heat-generating waste and waste with negligible heat generation was implemented with particular regard for repository-relevant aspects; it also applies when the waste packages for disposal are stored in a long-term overground interim storage facility prior to transportation into a repository. This waste categorisation has not only proven expedient at national level, but is also applied internationally – e. g. by the Commission of the European Union – in connection with the categorisation of radioactive waste. It is also compatible with the IAEA proposal for qualitative categorisation [IAEA 95] which additionally permits a further subdivision into short-lived and long-lived waste, thus allowing waste to be assigned to either “near-surface repositories” or “underground repositories”.

Furthermore, in the case of underground repositories, a distinction is made between high-level (heat-generating) waste on the one hand, and low-level / intermediate-level radioactive waste (waste with negligible heat generation) on the other. Since the IAEA proposal for categorisation is geared towards both near-surface disposal and disposal in deep geological formations, and its quantitative assertions deviate from the existing peripheral conditions in Germany based on plans for the disposal of radioactive waste, the direct adoption of this proposal is deemed inappropriate.

Examples of heat-generating radioactive wastes include the fission product concentrate, shells, structural components and feed sludge from the reprocessing of spent fuel elements, and the fuel elements themselves if there are no plans to reprocess them but instead to dispose of them directly as radioactive waste. Radioactive waste with negligible heat generation encompasses all other types of waste such as metals and non-metals, filters and filter aids, readily and poorly combustible materials, biological waste and waste water, sludges/suspensions as well as oils, solvents or emulsions.

The term “radioactive waste with negligible heat generation” was quantified within the scope of the planning work for the Konrad repository project. According to the application dated 31 August 1982, there are plans to dispose of low-level radioactive waste and radioactive waste from the decommissioning of nuclear facilities in the mine openings of the Konrad repository. Initially, implementation of this plan meant that the prevailing temperature conditions underground would only be influenced to a negligible extent by the waste packages stored there. Eventually, this led to the quantitative stipulation that the increase in temperature at the wall of the disposal chamber caused by decay heat from the radionuclides contained in the waste packages must not exceed 3 Kelvin on average. This value is roughly equivalent to the temperature difference which occurs with a difference in depth of 100 m in the natural temperature environment, and is low compared with the change of temperature caused by ventilation.

This classification makes it possible, in particular, to register the data for waste/waste packages required for description and characterisation, and therefore ensures the necessary degree of flexibility with respect to waste generated in future, as well as any changes/new developments in conditioning. It subdivides the different waste streams according to origin, waste container, immobilisation and waste type. With regard to the origin of the radioactive waste, generally speaking, a distinction is made between different waste producer groups. Canisters, cast-iron containers, concrete containers, drums or box-shaped containers are predominantly used for packaging radioactive waste, whilst glass and cement/concrete are widely used for the purposes of immobilisation. Regarding waste type, it would seem appropriate to use a standardised nomenclature (cf. Annex X of the Radiation Protection Ordinance (StrlSchV)). A more precise grouping can be achieved by further subdividing or supplementing this rough categorisation. This categorisation scheme allows the description of radioactive waste to be systematised in a way which fulfils the requirements for proper registration and description of all existing waste and waste arising in the foreseeable future.

On this basis, further elaboration, including a site-specific safety assessment for a repository in deep geological formations, eventually leads to facility-related waste acceptance requirements, stipulating quantitative requirements governing radioactive waste which is intended for disposal. The “Requirements Governing the Acceptance of Radioactive Wastes for Disposal” (*Endlagerungsbedingungen*, last edited: December 1995, Konrad Mine) [BfS 95] is one such example. These requirements specify the final description or categorisation of waste from a repository-specific point of view.

Section C. Scope of Application

Article 3 (Scope of application)

> *Article 3*
>
> *1. This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.*

The safety of spent fuel management within the meaning of this Article is applicable to all spent fuel from German nuclear power plants and research reactors which is intermediately stored with the intention of disposal. Those German fuel elements which are delivered to France or the United Kingdom for reprocessing do not fall within the scope of this Article, and are therefore not subject to reporting here.

Spent fuel elements from research reactors which are returned to their country of origin likewise fall outside the scope of this Convention and are therefore exempt from reporting in this report.

Reprocessing at the reprocessing plant in Karlsruhe was discontinued in 1990; the plant has been shut down and is currently in the process of being dismantled. The Karlsruhe Vitrification Plant (VEK) is currently being built to vitrify the liquid high-level waste still present at the site. There were aspirations to construct a new reprocessing plant, but these have never been implemented.

> *Article 3*
>
> *2. This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.*

The Basic Safety Standards of the IAEA [IAEA 96] contain common regulations on radioactive material from nuclear installations or from other licensed uses of radioactivity, as well as waste containing only naturally occurring radioactive material (NORM) (cf. Section 2.1 of the Basic Safety Standards of the IAEA). In the Member States of the European Union, on the other hand, these two areas are regulated separately in the EU Basic Safety Standards [EUR 96], and in principle, different requirements (e.g. with regard to exemption provisions) apply to NORM than to radioactive material from nuclear installations and other handling. In keeping with the Basic Safety Standards of the European Union, the German Radiation Protection Ordinance (StrlSchV) likewise makes a distinction between:

- *practices*, which are regulated in part 2 of the Radiation Protection Ordinance [1A-8] and which refer to the use of radioactive material and ionising radiation, and
- *work activities*, which are regulated in part 3 of the Radiation Protection Ordinance and which refer to natural sources of radiation.

This Convention only applies to practices, not to work activities. The distinction between these two terms is best clarified by the definitions provided in Section 3 of the StrlSchV:

Practices refer to the use of a material's radioactive properties. This may include, for example, the operation of nuclear installations, fuel element production, isotope production, and applications of radioactive material (especially radiation sources), e.g. in industry and research. On the other hand, work activities refer to actions involving materials which, although they contain naturally occurring radionuclides, are not used for their radioactive properties. Examples include the use of building materials containing radionuclides from the U 238, U 235, and Th 232 decay chains, as well as the nuclide K 40, excavated materials from mining activities, fly ashes from combustion processes, residues from the flue-gas purification of coal-fired power plants etc.

In accordance with Appendix XII, parts B and C of the Radiation Protection Ordinance (StrlSchV), tiered monitoring limits in the form of mass-related activity limits apply to materials originating from work activities. Provided these limits are not exceeded, the material is exempt from monitoring under radiation protection legislation.

Investigations are currently underway in Germany to ascertain the extent to which NORM residues listed in Annex XII, part A of the StrlSchV which exceed the monitoring limits specified in Appendix XII, parts B or C of the StrlSchV and which lead to effective individual doses of more than 1 mSv/a for members of the general public, are to be classified as radioactive waste as defined by this Convention.

Article 3

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

There are no spent fuel elements from military or defence programmes in Germany.

The radioactive waste from military or defence programmes remains the responsibility of the armed forces and is not transferred to civil responsibility until it is delivered to a repository. Until this time, it is placed in interim storage after having been conditioned according to the acceptance criteria of the repository. All these waste management stages are subject to the same safety provisions as those applicable in the civil sector.

Section D. Inventories and Lists

Article 32 (Reporting), Paragraph 2

Article 32

2. This report shall also include:

Article 32 2.

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

An overview of spent fuel management facilities (interim storage, conditioning) can be found in the following Table D–1. More detailed information on existing and planned facilities can be found in Annex L-(a).

The following facilities are classified as spent fuel management facilities within the meaning of the Convention:

- the dry interim storage facilities at the reactor sites, including temporary storage facilities (so-called *Interimslager*),
- the interim storage facilities at Greifswald (ZAB, ZLN) for spent fuel from the nuclear power plants at Rheinsberg and Greifswald, and the storage facility at Jülich for spent fuel from the high-temperature reactor AVR,
- the central interim storage facilities at Gorleben (TBL-G) and Ahaus (BZA), and
- the pilot conditioning plant at Gorleben (PKA).

The decommissioned waste fuel reprocessing plant at Karlsruhe (WAK) is dealt with under the comments on Article 32 2. (v).

The spent fuel assemblies unloaded from the reactor core are first placed in cooling ponds within the reactor building. These pools allow the required subsidence in activity and heat generation until the fuel is shipped for reprocessing or placed in a storage container for interim storage, and provides the operator with sufficient flexibility to operate the plant. The additional wet storage facility outside the reactor building at Obrigheim is an exceptional case. As this facility, like the cooling ponds inside the reactor buildings, is considered part of the power plant operation from a licensing point of view, it will not be considered in any further detail for the purposes of this report. It is, however, included in the tables for the sake of completeness.

With regard to direct disposal, a remaining period of several decades still needs to be bridged, depending on the availability of a repository and the length of time required for heat generation to subside until disposal. The Federal Government's concept envisages that in future, spent fuel assemblies should be placed in interim storage at the reactor sites where they are generated, and should remain there until duly conditioned and disposed of in a repository. For containers, an application has been submitted for a maximum storage period of 40 years from the date of loading. Interim storage at the site means that the number of fuel element transportations will be reduced.

For twelve reactor sites, licence applications for the interim storage of spent fuel assemblies have been submitted to the authorities in accordance with Section 6 of the Atomic Energy Act (AtG)

[1A-3]. The storage facilities are designed as dry storage facilities where the spent fuel assemblies are loaded into transportation/storage containers and placed in new storage buildings to be constructed on site. The containers are cooled by passive air convection which removes the heat from the containers without any active technical systems. The leak-proof and accident-resistant containers ensure safe enclosure as well as the necessary degree of radiation shielding and criticality safety during both normal operation and in the case of incidents. The heat is released into the environment by means of cooling fins. Protection against external impacts, such earthquakes, explosions and aircraft crashes, is ensured by the thick walls of the containers.

Basically, there are two design options for interim storage facilities. In the first option, the storage building consists of two parts being separated by a wall in the middle of the building. The wall thickness is approximately 70 to 85 cm, and the roof thickness approximately 55 cm. In the other concept, the storage buildings have no separating wall. The wall thickness is approximately 120 cm, and the roof thickness approximately 130 cm. The individual storage facilities each have a capacity of between 80 and 192 storage positions for suitable storage containers. The storage facility at Neckarwestheim is a special case, where it is envisaged that the containers will be stored in two tunnels lined with gunite. This special underground solution was developed to accommodate the specific situation of the site. The Stade power plant has withdrawn its application for the storage of spent fuel assemblies under Section 6 of the Atomic Energy Act (AtG) because the reactor is due to be shut down in 2003. In the Obrigheim plant, an increase of the wet storage capacity was licensed in 1998, and this should now be sufficient until the end of the reactor's operational life. Provided all the licences are granted, all nuclear power plants currently in operation, with the exception of Stade and Obrigheim, will have dry interim storage facilities at their sites in the future. If the licensing proceeds on schedule, all interim storage facilities are expected to be commissioned by 2006.

As a transitional solution until the on-site storage facilities are complete, and in order to avoid any disposal shortfalls, five nuclear power plant operators have applied for temporary storage facilities (so-called *Interimslager*) under Section 6 of the Atomic Energy Act (AtG). These installations have a capacity of up to 28 storage positions with a mobile concrete enclosure for each container. The intention is that the containers will be transferred to the respective on-site storage facility within a limited period of time. The containers in the temporary storage facilities are likewise cooled by passive air convection. The containers, combined with the concrete enclosures, ensure compliance with the admissible dose limits stipulated by the Radiation Protection Ordinance (StrlSchV) [1A-8]. For three sites (Biblis, Neckarwestheim, Philippsburg), the licences for the temporary storage facilities have already been granted, and a number of containers have already been emplaced.

The interim storage facilities at Greifswald/Rubenow and Jülich should be considered a special case. Although constructed outside of the reactor sites, they are nevertheless closely linked to certain nuclear reactors. The dry “Interim Storage Facility North” (ZLN) only accepts fuel assemblies from the Soviet-type reactors at Rheinsberg and Greifswald, some of which are currently being stored in a nearby wet storage facility (ZAB). The storage facility at Jülich contains spent fuel assemblies (spheres) from the prototype high-temperature reactor AVR.

Central storage facilities containing fuel assemblies from various German nuclear power plants have been licensed at Gorleben and Ahaus. The facilities are designed as dry storage facilities. Here too, the types of containers are in part identical with those already mentioned above in conjunction with onsite storage facilities. The Ahaus facility is licensed for HTR and LWR fuel assemblies, whilst the Gorleben facility is licensed for LWR fuel assemblies and HAW canisters. A certain number of storage positions has been allocated to the respective utility companies, but with the exception of the storage of HAW, only a small number of these are to be used so as to avoid the need for transportation.

Table D–1: a) Storage facilities for spent fuel assemblies (March 2003)

Site	Storage capacity	Storage capacity	Status	
	(number of storage positions)	(t HM)	Applied for	Licensed
Onsite storage facilities				
Biblis	135 container positions	1400 t HM	X	
Brokdorf	100 container positions	1000 t HM	X	
Brunsbüttel	80 container positions	300 t HM	X	
Grafenrheinfeld	88 container positions	800 t HM		X
Grohnde	100 container positions	1000 t HM		X
Gundremmingen	192 container positions	2250 t HM	X	
Isar	152 container positions	1500 t HM	X	
Krümmel	80 container positions	800 t HM	X	
Lingen/Emsland	125 container positions	1250 t HM		X
Neckarwestheim	151 container positions	1600 t HM	X	
Obrigheim [1)]	980 fuel element positions	286 t HM		X
Philippsburg	152 container positions	1600 t HM	X	
Unterweser	80 container positions	800 t HM	X	
Temporary storage facilities				
Biblis	28 container positions	300 t HM		X
Brunsbüttel	18 container positions	140 t HM	X	
Krümmel	12 container positions	120 t HM	X	
Neckarwestheim	24 container positions	250 t HM		X
Philippsburg	24 container positions	260 t HM		X
Central storage facilities				
Gorleben	420 container positions [2)]	3800 t HM		X
Ahaus	420 container positions	3960 t HM		X
Local storage facilities outside the reactor sites				
ZAB Greifswald	4680 fuel element positions	560 t HM		X
ZLN Greifswald	80 container positions	585 t HM		X
Jülich	158 containers	0.225 t nuclear fuel [3)]		X

1) The storage facility at Obrigheim is a wet storage facility outside of the reactor building that was commissioned in 1999. Consequently, an additional onsite temporary storage facility is not necessary.
2) Including the positions for HAW canisters
3) Excluding thorium

b) Conditioning plants

Facility	Site	Purpose	Capacity	Status
PKA	Gorleben	Repair of defective containers	35 t HM/a	Licensed and constructed but not yet in operation

The German reference concept for direct disposal envisages that the spent fuel assemblies should be packaged in sealed thick-walled containers and emplaced in deep geological formations. In order to demonstrate the conditioning technique, a pilot conditioning plant (PKA) was planned and constructed at Gorleben. Pursuant to the agreement between the Federal Government and the utilities of 14 June 2000 (signed on 11 June 2001) the licensing procedure is complete, but use of the facility is restricted to the repair of defect containers. It is restricted to a maximum throughput of 35 tHM/a and the handling of other radioactive materials. At present, the granted licence cannot be utilised because a number of actions have been brought against it.

Article 32 2.

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

An overview of the spent fuel produced in German nuclear power plants up to the end of December 2001 is given in Table D–2 (classified according to place of origin) and Table D–3 (classified according to destination). Table D–4 lists the destinations of prototype reactor fuels, whilst Table D–5 contains information on the estimated mass of plutonium contained in stored fuel assemblies.

19 power reactors are currently operational in the Federal Republic of Germany, all of which are light water reactors whose fuel assemblies consist of low-enriched uranium dioxide or mixed uranium-plutonium oxide (MOX). A further 10 power reactors have been shut down. 7 experimental and prototype power plants formerly operating in the Federal Republic of Germany have likewise been shut down. Two of them, HDR at Großwelzheim (completely dismantled since 1998) and VAK at Kahl, were boiling water reactors fuelled with low-enriched uranium dioxide pellets, whilst MOX was also used to a certain extent in the case of VAK. Two further reactors, AVR at Jülich and THTR at Hamm-Uentrop, were helium-cooled, graphite-moderated high-temperature reactors in which the fuel, consisting of medium- and high-enriched uranium/thorium oxide particles, was enclosed in graphite spheres. The MZFR at Karlsruhe was a heavy-water reactor with very low enriched (0.85 %) uranium dioxide fuel. The fast breeder reactor KNK II at Karlsruhe used fuel assemblies made of highly enriched uranium oxide and mixed uranium/plutonium oxide. The nuclear power plant at Niederaichbach (KKN) was operational as a prototype plant from 1972 to 1974 with a pressure tube reactor moderated with heavy water and cooled by CO_2, which used natural uranium as fuel. Complete dismantling (leaving behind a greenfield site) was finished in 1995.

<u>Spent Fuel Quantities</u>

Power Reactors

By the cut-off date of 31 December 2001, 10114 tonnes of heavy metal (t HM) in the form of spent fuel assemblies had been produced from 19 operating and 10 decommissioned power reactors (Table D–2). This quantity includes 8982 t HM of fully spent fuel assemblies, whilst the remaining 1132 t HM refers to spent fuel assemblies which have yet to reach their final burn-up and which are due to be reused at a later date, depending on the decision of the operators.

2342 t HM of spent fuel assemblies and 1132 t HM of partially spent fuel assemblies are currently being stored in the cooling ponds of the power plants. There are 347 t HM of fuel assemblies from water cooled, water moderated energy reactors (WWER) at the wet storage facility ZAB in Lubmin near Greifswald. Temporary and interim storage facilities are based on the concept of dry storage using storage containers. 77 t HM are currently housed in this way in temporary storage facilities, whilst a further 96 t HM of LWR fuel assemblies are stored in containers at the central storage facilities at Ahaus and Gorleben. 184 t HM of WWER fuel assemblies from Rheinsberg and Greifswald are likewise stored in containers at the ZLN interim storage facility at Lubmin near Greifswald. As of 31 December 2001, a further 121 t HM of fuel assemblies was stored in containers at German power plants awaiting transportation.

5817 t HM of spent fuel assemblies have already been shipped from the nuclear power plants to other sites, the majority having been sent to the reprocessing plants at La Hague and Sellafield. Table D–3 gives an overview of the destinations of the fuel assemblies.

Table D–2: Quantities of spent fuel assemblies produced in power reactors in the Federal Republic of Germany up until 31 December 2001

Type	Abbre-viation	Power plant, site	Total quantity		Of which			
					Spent		Partially spent	
			No. of FE	t HM	No. of FE	t HM	No. of FE	t HM
Plants in operation:								
BWR	KKB	Brunsbüttel	1732	301	1728	301	4	0.7
BWR	KKK	Krümmel	2349	416	2348	416	1	0.2
PWR	KBR	Brokdorf	668	361	530	286	138	75
PWR	KKS	Stade	1324	476	1298	467	26	9
PWR	KKU	Unterweser	1144	614	1059	568	85	46
PWR	KWG	Grohnde	828	451	590	321	238	130
PWR	KKE	Emsland	732	394	354	191	378	203
PWR	KWBA	Biblis A	1180	632	962	515	218	117
PWR	KWBB	Biblis B	1223	654	916	490	307	164
PWR	KWO	Obrigheim	1074	313	1066	311	8	2
BWR	KKP1	Philippsburg 1	2288	401	2272	398	16	3
PWR	KKP2	Philippsburg 2	852	460	792	428	60	32
PWR	GKN1	Neckarwestheim 1	1309	473	1277	461	32	12
PWR	GKN2	Neckarwestheim 2	624	336	572	308	52	28
BWR	KRBB	Gundremmingen B	2776	483	2201	383	575	100
BWR	KRBC	Gundremmingen C	2725	474	1902	331	823	143
BWR	KKI1	Isar 1	2668	464	2648	461	20	3
PWR	KKI2	Isar 2	652	349	610	326	42	23
PWR	KKG	Grafenrheinfeld	1012	543	935	502	77	41
Subtotal:			**27160**	**8595**	**24060**	**7464**	**3100**	**1131**

Type	Abbre-viation	Power plant, site	Total quantity		Of which			
					Spent		Partially spent	
			No. of FE	t HM	No. of FE	t HM	No. of FE	t HM
Decommissioned plants:								
BWR	KWL	Lingen	586	66	586	66	0	0
BWR	KRB-A	Gundremmingen A	1028	120	1028	120	0	0
BWR	KWW	Würgassen	1989	346	1989	346	0	0
PWR	KMK	Mülheim-Kärlich	209	96	209	96	0	0
PWR	KKR	Rheinsberg	918	108	918	108	0	0
PWR	KGR 1-4	Greifswald 1-4	6464	755	6464	755	0	0
PWR	KGR 5	Greifswald 5	349	42	114	14	235	28
Subtotal			**11543**	**1533**	**11308**	**1505**	**235**	**28**
Total:			**38703**	**10128**	**35368**	**8969**	**3335**	**1159**

Note: The quantities given in tHM have been rounded to the nearest whole number. This may result in minor differences compared with other published figures.

Table D–3: Overview of total quantities from German power reactors up to 31 December 2001:

Spent fuel assemblies in wet stores at nuclear power plants	2342	t HM
Partially spent fuel assemblies in wet stores at nuclear power plants	1132	t HM
Spent WWER fuel assemblies at the ZAB wet storage facility	347	t HM
Dry storage of spent WWER fuel assemblies in containers at ZLN	184	t HM
Dry storage in containers at temporary storage facilities	77	t HM
Dry storage in containers at the Ahaus and Gorleben interim storage facilities	96	t HM
Emplacement of spent fuel assemblies in containers awaiting transportation	121	t HM
Shipped to La Hague (France) for reprocessing	4704	t HM
Shipped to Sellafield (United Kingdom) for reprocessing	681	t HM
Reprocessed at the WAK reprocessing plant in Karlsruhe	90	t HM
Reprocessed at the Mol reprocessing plant (Belgium)	15	t HM
Returned to the former USSR (WWER fuel assemblies)	293	t HM
Shipped permanently to Sweden (CLAB)	17	t HM
Reuse of WWER fuel assemblies at Paks (Hungary)	28	t HM

Research Reactors

As per the beginning of 2003, there were 13 research reactors in operation in Germany, comprised of:

- 4 materials test reactors (MTRs) (Berlin, Geesthacht, Jülich and Munich)
- 1 TRIGA reactor at Mainz

- 8 training / educational reactors, including 6 Siemens educational reactors (SUR).

Furthermore, 7 reactors with thermal outputs in excess of 1 MW have been shut down and are in varying stages of decommissioning. Several other lower-output reactors have been decommissioned or have already been dismantled. A list of decommissioned research reactors can be found in the Annex to this report, cf. Table L–12 and Table L–13.

7.2 t of spent fuel assemblies were stored at the sites of these reactors as of May 2001. Because the fuel in research reactors is bound in an aluminium alloy, the indicated masses do not refer to the content of heavy metal, as it is the case for power reactors, but to the total weight of the fuel assemblies.

Prototype reactors
Seven experimental and prototype reactors were once operated in Germany, all of which have since been decommissioned. These are:

- AVR, Jülich
- THTR-300, Hamm
- MZFR, Karlsruhe
- KNK-2, Karlsruhe
- VAK, Kahl
- KKN, Niederaichbach
- HDR, Großwelzheim

For comparative data on these reactors, please refer to Table L–11 in the Annex. Table D–4 lists the destinations and respective heavy metal quantities for storage or management of the 186 t HM of spent fuel assemblies thereby incurred.

Table D–4: Management of spent fuel assemblies from prototype reactors

Reactor	**Quantities stored or disposed of (in t HM) at**								**Total**
	WAK	**BNFL**	**SKB**	**CEA**	**EURO-CHEMIC**	**FZ Jülich**	**TBL-A Ahaus**	**Others**	
VAK	7.9	0.1	6.5		7.4			0.1	22.0
MZFR	89.6	10.6	0.4						100.6
KKN				46.3					46.3
KNK-2				1.9				0.2	2.1
AVR						1.1			1.1
THTR							6.9		6.9
HDR	6.9								6.9
Total	**104.4**	**10.7**	**6.9**	**48.2**	**7.4**	**1.1**	**6.9**	**0.3**	**185.9**

Most of the spent fuel assemblies listed in the above table were reprocessed at WAK Karlsruhe, at BNFL or at EUROCHEMIC in Belgium. A smaller part of the fuel assemblies was shipped to SKB in Sweden or to CEA in France and will remain there. The THTR fuel element spheres have already been declared as radioactive waste (cf. the remarks on Article 32 2. (iv)) and are currently being stored at the Ahaus interim storage facility. The 6.9 t of heavy metal are contained in 617629 spheres which are stored in 305 containers. The AVR fuel element spheres are stored at the Jülich research centre, where 240962 fuel element spheres with 1.1 t of heavy metal (including thorium) have been emplaced in 127 containers.

Inventory of Spent Fuel Assemblies

Activity

The activity of the spent and partially spent fuel assemblies (reference date: 31 December 2001) can be estimated based on the following assumptions:

In an initial approximation, no distinction is made between mixed oxide and uranium dioxide fuel, because fission products determine the activity content. The plutonium content is listed separately in Table D–5. Based on a survey of spent fuel management conducted annually in Germany, the fuel assemblies are divided into three categories on the basis of age: For those fuel assemblies unloaded prior to 1997, the assumed mean burn-up is 40 GWd/tHM, whilst for those unloaded between 1997 and 2001, the mean burn-up is defined as 45 GWd/tHM, and for partially spent fuel assemblies, the mean burn-up is assumed at 20 GWd/tHM.

Based on these assumptions, the radioactive inventories may be estimated as follows:

- Inventory of spent fuel stored in NPP cooling ponds (corresponding to 2342 t HM) $1.1 \cdot 10^{20}$ Bq
- Inventory of partially spent fuel stored in NPP cooling ponds (corresponding to 1132 t HM) $4.9 \cdot 10^{19}$ Bq
- Spent fuel assemblies in containers, interim and temporary storage facilities $2.1 \cdot 10^{19}$ Bq

Thus, the total activity of all spent fuel assemblies currently in storage as per the reference date is approximately $1.8 \cdot 10^{20}$ Bq.

The activity of Sr-90 can be estimated at $1.2 \cdot 10^{19}$ Bq (excluding the activity of Y-90), whilst the activity of Cs-137 can be estimated at $1.6 \cdot 10^{19}$ Bq (excluding the activity of Ba-137m).

Plutonium

When estimating the plutonium content in existing spent and partially spent fuel assemblies, MOX fuel assemblies and UO_2 fuel assemblies are considered separately.

106 t HM of spent MOX fuel and 9 t HM of partially spent MOX fuel were stored in the wet storage facilities of the power plants as per the reference date. The following Table D–5 shows the estimated plutonium quantities for the fuel assemblies in the various storage facilities. For the purposes of this estimate, we have assumed a plutonium content of 11 kg Pu per t HM for spent UO_2 fuel assemblies, and 7.5 kg Pu per t HM for partially spent UO_2 fuel assemblies. The corresponding figures for MOX are 40 kg Pu per t HM for spent fuel assemblies, and 67 kg Pu per t HM for partially spent fuel assemblies. In total, 46.9 t plutonium is currently being stored in processed form in spent fuel assemblies in Germany.

Table D–5: Estimated plutonium masses in stored fuel assemblies (as per 31 December 2001)

Contained in 106 t HM of spent MOX fuel in wet storage facilities at NPPs	4.2	t Pu
Contained in 9 t HM of partially spent MOX fuel in wet storage facilities at NPPs	0.6	t Pu
Contained in 2236 t HM of spent UO_2 fuel in wet storage facilities at NPPs	24.6	t Pu
Contained in 1123 t HM of partially spent UO_2 fuel in wet storage facilities at NPPs	8.4	t Pu
Contained in 530 t HM of spent WWER fuel at ZLN and ZAB	5.8	t Pu
Contained in 96 t HM of spent fuel in interim storage facilities at Ahaus and Gorleben	1.0	t Pu
Contained in 77 t HM of spent fuel (incl. 4 t HM MOX) in temporary storage facilities	1.0	t Pu
In containers awaiting transportation, containing 120 t HM of spent fuel	1.3	t Pu
Total	**46.9**	**t Pu**

Article 32 2.

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

Detailed data on the available conditioning facilities, interim storage facilities and repositories for radioactive waste can be found in Annex L-(b).

Due to the operation and decommissioning of nuclear facilities and installations, and the use of radioisotopes in research, trade, industry and medicine, radioactive waste is continuously produced in the Federal Republic of Germany and must be intermediately stored until the repository is commissioned.

The conditioning of radioactive waste may start with primary waste – possibly pre-treated – which has been specifically collected and sorted, or with an interim product. Conditioning comprises the treatment and/or packaging of radioactive waste. Conditioning comprises variety of procedures and facilities, some of which have been tested over a period of many years, as follows:

- Solid primary waste (which may be pre-treated) and interim products are processed by means of crushing, packaging, drying, burning, pyrolysis, melting, compacting or cementing.
- Liquid waste (which may be pre-treated) is processed by means of drying, cementing or vitrification
- Generally speaking, the packaging of waste products is based on a system of standardised waste containers which have been carefully designed to meet safety-related and operational requirements and agreed between all the parties involved.

Frequently used stationary waste conditioning facilities are located in Braunschweig, Duisburg, Hanau, Jülich, Karlsruhe, Karlstein, Krefeld and Lubmin near Greifswald. These comprise decontamination and dismantling facilities, drying facilities, evaporator facilities, high-pressure compaction facilities, melting facilities and cementing facilities that are also available for the processing of waste from external waste producers. Mobile waste management facilities are also available which can be erected on site at a waste producer’s premises in order to process radioactive waste held in storage there.

Until shipped into a repository for disposal, radioactive waste from the operation and decommissioning of nuclear power plants must be stored intermediately in facilities to be erected and operated by the waste producer in accordance with the polluter pays principle. At present, in addition to on-site facilities, intermediate storage facilities are also available at the Gorleben waste storage facility, the interim storage facility of the Bavarian utilities in Mitterteich, the external storage hall in Unterweser, the North interim storage facility (Zwischenlager Nord, ZLN) near Greifswald and the interim storage of the Decontamination Plants Division (*Hauptabteilung Dekontaminationsbetriebe = HDB)* in Karlsruhe. The licences for these interim storage facilities contain restrictions regarding delivery. For example, only waste originating from Bavarian nuclear facilities may be brought to Mitterteich, only waste from the nuclear facilities in Greifswald and Rheinsberg currently in the process of decommissioning may be brought to the ZLN, and only waste originating from operation and decommissioning of facilities of the FZK and decommissioning wastes of the nuclear power plant at Niederaichbach may be brought to the HDB. Radioactive waste from the reprocessing of German spent fuel elements abroad may be stored in the central interim storage facility in Gorleben.

Radioactive waste from large research institutions is conditioned and stored intermediately at its place of origin. Waste from research, industry and medicine may be delivered to 11 regional State collecting facilities operated by the *Länder* (Federal States*)*. The waste is either accepted as primary waste and then conditioned on site, or has already been conditioned and is delivered in a form suitable for disposal. Private conditioning and waste management companies, such as e. g. AEA Technology QSA GmbH, are additionally available for waste from research, medicine and industry. This company collects radioactive residues from the whole of Germany and intermediately stores radioactive waste at its storage facility in Leese (Lower Saxony). Waste from the nuclear industry is either stored on site or in central interim storage facilities in a conditioned form suitable for disposal.

All intermediately stored radioactive waste which cannot be released once activity has subsided is intended for subsequent disposal in a repository. There are plans to dispose of the radioactive waste in deep geological formations. Development work in the repository field began with the establishment of the Asse research mine in a salt dome near Wolfenbüttel (Lower Saxony), where the disposal of low-level and medium-level radioactive waste was trialled up until the end of 1978. In the former GDR, the Morsleben repository for radioactive waste (ERAM) in Saxony-Anhalt was available for the disposal of low-level and medium-level radioactive waste. Following Germany's reunification, ERAM was taken over and accepted waste from nuclear power plants and from research, medicine and industry in Germany up until September 1998.

In 1982, an application was filed to dispose of non-heat-generating waste at the Konrad repository, a former iron ore mine in Lower Saxony. The licensing procedure for the Konrad repository has been concluded and was issued solely to meet national requirements, for a maximum emplaceable waste package volume of 303000 m³. A licence was granted on 22 May 2002, but has not yet entered into force because an appeal has been launched against the decision.

At the Gorleben site (Lower Saxony), underground exploration work of the salt dome located there started in 1986, in order to ascertain whether the salt dome might likewise be suitable for use as a repository for high-level radioactive waste. Within the context of exploration, two shafts of approximately 800 m depth were sunk and connected to one another. Exploration of the Gorleben salt dome was interrupted on 1 October 2000 for a minimum of three years but no more than ten years. During this moratorium period, the mine will remain open. The interruption will be used to clarify safety-related and conceptual queries relating to disposal, and also to develop a procedure and scientifically established criteria for the identification and selection of one site for the safe disposal of all types of radioactive waste. To this end, a Committee on a Site Selection Procedure for Repository Sites (AKEnd) was set up in February 1999.

Article 32 2.

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

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

b) has been disposed of; or

c) has resulted from past practices.

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

In the Federal Republic of Germany, radioactive waste is generated from

- the operation of nuclear power plants,
- uranium enrichment and the production of fuel elements (nuclear industry),
- the decommissioning and dismantling of nuclear power plants, research, demonstration and educational reactors, and other nuclear installations,
- basic and applied research,
- the use of radioisotopes in other research institutions, universities, trade and industry companies, hospitals and medical practices,
- other waste producers, such as the military sector.

In addition to this, allowance must also be made for spent fuel elements – particularly from light-water reactors – and the waste generated in future when these fuel elements are conditioned for direct disposal.

According to contractual agreements with the reprocessing companies COGEMA – Compagnie Générale des Matières Nucléaires (France) and BNFL – British Nuclear Fuels plc (United Kingdom), Germany must accept the return of an equivalent amount of radioactive waste obtained from the reprocessing of spent fuel elements from light-water reactors. Whilst return of the vitrified fission product concentrate from COGEMA/France commenced in May 1996 and will continue at regular intervals, the return delivery of radioactive waste from BNFL is currently still at the planning stage.

Further contracts were concluded with the United Kingdom (UKAEA – United Kingdom Atomic Energy Agency) to reprocess a limited number of spent fuel elements from research reactors. The radioactive waste generated from reprocessing will likewise be returned to Germany.

The following sections contain an overview of the stock of untreated radioactive residues, together with the inventory of intermediate waste products and conditioned waste as per 31 December 2000, and an estimate of the current level of capacity utilization at the storage facilities for radioactive waste. An overview of the radioactive waste disposed of in the ERAM repository at Morsleben is also provided.

<u>Stock of Radioactive Waste</u>

The stock of radioactive waste for the aforementioned waste producer groups can be found in the tables below. The waste producers included and their assignment to waste producer groups are listed in Table D–6, which is updated annually.

Table D–6 Waste producers and their assignment to waste producer groups

Waste producer	Group
Europäisches Institut für Transurane - ITU -	Research institution
Forschungs- und Messreaktor Braunschweig - FMRB	Research institution
Research Reactor Munich	Research institution
Forschungszentrum Geesthacht GmbH	Research institution
Forschungszentrum Jülich GmbH - FZJ -	Research institution
Forschungszentrum Karlsruhe GmbH - FZK -	Research institution
Hahn-Meitner-Institut Berlin GmbH	Research institution
Institut für Radiochemie TU München	Research institution
VKTA Rossendorf	Research institution
Advanced Nuclear Fuels GmbH	Nuclear industry
Nukem GmbH	Nuclear industry
Siemens AG Power Generation Rückbauprojekte	Nuclear industry
Framatome ANP GmbH	Nuclear industry
Siemens AG - Betriebsteil Uranverarbeitung Hanau	Nuclear industry
Siemens Brennelementewerk Hanau/MOX	Nuclear industry
Urenco GmbH Gronau	Nuclear industry
Urenco GmbH Jülich	Nuclear industry
Biblis A und B nuclear power plant	Nuclear power plant
Brokdorf nuclear power plant	Nuclear power plant
Brunsbüttel nuclear power plant	Nuclear power plant
Emsland nuclear power plant	Nuclear power plant
Grafenrheinfeld nuclear power plant	Nuclear power plant
Grohnde nuclear power plant	Nuclear power plant
Gundremmingen nuclear power plant, units B and C	Nuclear power plant
Isar 1 nuclear power plant	Nuclear power plant
Isar 2 nuclear power plant	Nuclear power plant
Krümmel nuclear power plant	Nuclear power plant
Mülheim-Kärlich nuclear power plant	Nuclear power plant, decommissioning applied for in 2001
Neckarwestheim nuclear power plant, units 1 and 2	Nuclear power plant
Obrigheim nuclear power plant	Nuclear power plant
Philippsburg nuclear power plant, units 1 and 2	Nuclear power plant
Stade nuclear power plant	Nuclear power plant
Unterweser nuclear power plant	Nuclear power plant
Greifswald nuclear power plant	Decommissioned nuclear power plant
Gundremmingen nuclear power plant, unit A	Decommissioned nuclear power plant
Hamm-Uentrop - THTR – nuclear power plant	Decommissioned nuclear power plant
Jülich - AVR – nuclear power plant	Decommissioned nuclear power plant
Lingen nuclear power plant	Decommissioned nuclear power plant
Rheinsberg nuclear power plant	Decommissioned nuclear power plant
Würgassen nuclear power plant	Decommissioned nuclear power plant
Kernkraftwerk-Betriebsgesellschaft KNK of FZK	Decommissioned nuclear power plant
Kernkraftwerk-Betriebsgesellschaft MZFR of FZK	Decommissioned nuclear power plant
Versuchsatomkraftwerk Kahl - VAK -	Decommissioned nuclear power plant
Abfalllager Gorleben - ALG -	Others
AEA Technology QSA GmbH	Others
Military sector	Others
Karlsruhe reprocessing plant – WAK -	Reprocessing
Baden-Württemberg collecting facility	State collecting facility

Waste producer	Group
Bavaria collecting facility	State collecting facility
Berlin collecting facility	State collecting facility
Hesse collecting facility	State collecting facility
Mecklenburg-Western Pomerania collecting facility	State collecting facility
Lower Saxony collecting facility	State collecting facility
North Rhine-Westphalia collecting facility	State collecting facility
Rhineland-Palatinate collecting facility	State collecting facility
Saarland collecting facility	State collecting facility
Saxony collecting facility	State collecting facility
Schleswig-Holstein collecting facility	State collecting facility
Brandenburg provisional storage facility	State collecting facility (until 31st December 2001)

The stock of radioactive waste is determined both for radioactive waste with negligible heat generation, and for heat-generating radioactive waste. Table D–7 contains summarised data for the year 2000 for primary waste (untreated waste), interim products (treated waste), and waste packages (conditioned waste). This list does not include the stock of spent fuel elements (cf. remarks on Article 32 2. (ii)). The data on conditioned waste refers to the waste package volume.

Table D–7: Overview of the volumes of radioactive waste in interim storage as per 31 December 2000 [m³]

Type of residue	With negligible heat generation	Heat-generating
Untreated waste (utilisable residues and primary waste)	34193	450
Interim products	5283	
Conditioned waste	67220	1494

In total, some 34193 m³ of untreated waste was held in storage by all waste producers; this also includes utilisable residues which may be reused or released following appropriate action. The stock of interim products with negligible heat generation totalled 5283 m³, most of which was held in storage at the waste producers, with a small portion being held at central interim storage facilities. The stock of conditioned radioactive waste with negligible heat generation totalled 67220 m³ as per 31 December 2000. These stocks were likewise held in storage both at the waste producers and at interim storage facilities.

As of 31 December 2000, conditioned radioactive waste was stored in the form of 59843 waste packages. This stock is subdivided into

- 58857 waste packages with negligible heat generation and
- 986 waste packages with heat-generating waste.

Most of the processed waste with negligible heat generation is stored in drums, cylindrical concrete and cast-iron containers, and sheet-steel and concrete boxed-shape containers. For heat-generating waste, a variety of non-self-shielding and self-shielding containers are used.

Drums were used with varying capacities of 200 litres, 280 litres, 400 litres and 570 litres.

Detailed data on the stock of conditioned waste as per 31 December 2000 are summarised in Table D–8 for waste with negligible heat generation and in Table D–9 for heat-generating waste. Table D–10 shows the inventory (volume) of waste with negligible heat generation with reference to individual waste producer groups.

Table D–8: Breakdown of the stock of conditioned radioactive waste with negligible heat generation as per 31 December 2000 according to container type

Packaging of conditioned radioactive waste	Quantity
200 litre drum	36907
280 litre drum	1721
400 litre drum	1336
570 litre drum	125
Concrete container	9211
Cast-iron container	4039
Box-shaped container	5518
Total	**58857**

Table D–9: Breakdown of the stock of conditioned heat-generating waste as per 31 December 2000 according to container type

Packaging of conditioned radioactive waste	Quantity
200 litre drum	591
Type II cast-iron container	6
CASTOR® THTR/AVR*	305
CASTOR® HAW 20/28 CG** TS 28 V	2 1
Total	**905**

*) Article 32 2. (ii) (prototype reactors) also reports on the spent fuel elements contained in containers of the type CASTOR® THTR/AVR.

**) Further containers were emplaced in 2001 – cf. Table L–2 in the Annex

Table D–10: Overview of the stock of untreated primary waste, interim products and conditioned waste with negligible heat generation as per 31 December 2000 [m³]

Waste producer group	Untreated primary waste	Interim products	Conditioned waste
Research institutions	7411	484	32678
Nuclear industry	11171	404	3368
Nuclear power plants	6281	605	12415
Decommissioned nuclear power plants	5529	2692	3923
State collecting facilities	720	231	2700
Others	2171	867	0
Reprocessing	910	-	12136

Waste producer group	Untreated primary waste	Interim products	Conditioned waste
Total	**34193**	**5283**	**67220**

The mean annual production of conditioned waste with negligible heat generation totals approximately 4650 m³.

In addition to the stock of radioactive waste with negligible heat generation, some 450 m³ of heat-generating primary waste and 1494 m³ of heat-generating conditioned waste was held in storage in the Federal Republic of Germany as per 31 December 2000. The bulk of this originated from decommissioned nuclear power plants, particularly the Hamm-Uentrop high-temperature reactor (THTR). It is envisaged that the spherical fuel elements discharged from the THTR will be disposed of directly. 3 containers with 84 canisters containing vitrified fission product concentrate from the reprocessing of spent fuel elements at COGEMA are included under conditioned reprocessing waste. Heat-generating primary waste refers to fission product concentrate from the Karlsruhe reprocessing plant (WAK) and core scrap originating from the Würgassen nuclear power plant. Table D–11 contains a breakdown of heat-generating waste according to origin.

Table D–11: Overview of the inventory of untreated primary waste and conditioned heat-generating waste on 31st December 2000 [m³]

Waste producer group	Untreated primary waste	Conditioned waste
Research institutions	-	79
Nuclear industry	-	-
Nuclear power plants	-	6
Decommissioned nuclear power plants	390	1320
State collecting facilities		19
Others	-	-
Reprocessing	60	70
Total	**450**	**1494**

Conditioned radioactive waste, both with negligible heat generation and heat-generating, is stored at the waste producers´ sites and at internal and central interim storage facilities. Table D–12 summarises the stock of conditioned radioactive waste with negligible heat generation, classified according to the various interim storage facilities.

Table D–12: Interim storage of conditioned waste with negligible heat generation as per 31 December 2000 [m³]

Interim storage facility	Waste volume
Research centres including clients	48405
Nuclear industry	1935
Energiewerke Nord, Zwischenlager Nord	1205
Light water reactors	4985
Decommissioned reactors	295
State collecting facilities	1099
Others	875
Interim storage facility at the Unterweser nuclear power plant	461
Interim storage facility at the Mitterteich utility	3151
Gorleben waste storage facility	4019
GNS and other interim storage facilities	790
Total	**67220**

Disposed of Radioactive Waste

During the period from 1971 to 1991 and from 1994 to 1998, low-level and medium-level radioactive waste with comparatively low concentrations of alpha-emitters was emplaced in the Morsleben repository for radioactive waste (ERAM).

This waste originated from

- the operation of nuclear power plants,
- the decommissioning of nuclear facilities,
- the nuclear industry,
- research institutions,
- State collecting facilities or directly from small waste producers, and
- other users of radioactive materials.

In total, some 36753 m³ of solid waste and 6617 sealed radiation sources were emplaced in the repository. As a general rule, the emplaced radioactive waste is packaged in standardised containers, such as 200 to 570-litre drums and cylindrical concrete containers. The sealed radiation sources are not subjected to further treatment nor are they packaged. In addition to the disposed of radioactive waste, sealed cobalt radiation sources (including some cesium radiation sources) and small quantities of solid medium-level radioactive waste (europium waste) in seven special containers (steel cylinders) with a volume of 4 litres each and one 280 litre drum containing radium-226 waste are intermediately stored in deep boreholes at the ERAM facility. Within the scope of the licensing procedure for the decommissioning of the ERAM repository, an application was submitted to dispose of this intermediately stored waste.

The waste from nuclear power plants primarily refers to waste created during the operation of these facilities, such as mixed waste (contaminated work materials, protective clothing, tools, plastic film, filter paper, wire wool, insulating materials), building rubble, filters, metallic waste such as fittings, pipes and cables, dried evaporator concentrates, cemented evaporator concentrates and filter resins, as well as contaminated soil. The solid waste was packaged in a pressed or unpressed state in drums or cylindrical concrete containers. In addition to this waste, sealed radiation sources were also disposed of.

Radioactive waste from State collecting facilities consists primarily of pressed or unpressed mixed waste such as metals, filter materials, contaminated laboratory waste and laboratory equipment, resins, building rubble, cemented concentrates or solutions, and sealed radiation sources. This waste was packaged in drums or disposed of as radiation sources.

Building rubble, contaminated soil, cemented mixed waste both pressed and unpressed, metallic waste, combustion residues, contaminated laboratory waste, cemented rinse solutions and immobilised radiation sources were supplied to the ERAM repository as radioactive waste by research institutions and other waste producers. Most of the radioactive waste from these waste producers is packaged in 200 litre drums.

Waste data on the radioactive waste is documented and archived. The total activity of all emplaced radioactive waste is in the magnitude of 10^{14} Bq, with the activity of the alpha-emitters being in the region of 10^{11} Bq. Table D–13 provides an overview of the activity of the relevant radionuclides contained in the waste emplaced in the ERAM repository, including waste currently placed there for interim storage. The activity data refers to 30 June 2005.

The bulk of the emplaced waste volume originates from operational and decommissioned nuclear power plants. As the limit for the activity of alpha-emitters is very low at ERAM ($4 \cdot 10^8$ Bq/m³), the portion of the waste originating from the nuclear industry, research centres and reprocessing is low. Table D–14 shows the volume of waste emplaced in the ERAM repository, classified according to individual waste producer groups.

Table D–13: Radionuclide inventory of relevant radionuclides in the ERAM repository as per June 2005

Radionuclide	Activity in Bq	Radionuclide	Activity in Bq
H-3	$2.0 \cdot 10^{12}$	Th-229	$4.5 \cdot 10^{5}$
C-14	$3.2 \cdot 10^{12}$	Th-230	$1.7 \cdot 10^{6}$
Cl-36	$3.9 \cdot 10^{9}$	Th-232	$5.9 \cdot 10^{6}$
Ca-41	$7.3 \cdot 10^{7}$	Pa-231	$1.7 \cdot 10^{6}$
Co-60	$2.5 \cdot 10^{14}$	U-233	$5.1 \cdot 10^{6}$
Ni-59	$1.8 \cdot 10^{11}$	U-234	$7.0 \cdot 10^{8}$
Ni-63	$1.5 \cdot 10^{13}$	U-235	$4.4 \cdot 10^{7}$
Se-79	$1.9 \cdot 10^{8}$	U-236	$4.9 \cdot 10^{7}$
Rb-87	$2.7 \cdot 10^{7}$	U-238	$4.0 \cdot 10^{8}$
Sr-90	$2.9 \cdot 10^{12}$	Np-237	$8.5 \cdot 10^{7}$
Zr-93	$9.3 \cdot 10^{9}$	Pu-239	$6.9 \cdot 10^{10}$
Nb-94	$2.7 \cdot 10^{10}$	Pu-240	$6.6 \cdot 10^{10}$
Mo-93	$2.6 \cdot 10^{8}$	Pu-242	$1.2 \cdot 10^{8}$
Tc-99	$1.0 \cdot 10^{11}$	Pu-244	$2.1 \cdot 10^{4}$
Pd-107	$6.7 \cdot 10^{7}$	Am-241	$2.2 \cdot 10^{11}$
Sn-126	$2.4 \cdot 10^{8}$	Am-243	$9.5 \cdot 10^{7}$
I-129	$2.1 \cdot 10^{8}$	Cm-244	$6.6 \cdot 10^{9}$
Cs-135	$3.7 \cdot 10^{8}$	Cm-245	$2.3 \cdot 10^{6}$
Cs-137	$1.4 \cdot 10^{14}$	Cm-246	$2.7 \cdot 10^{6}$
Sm-151	$2.7 \cdot 10^{11}$	Cm-247	$2.6 \cdot 10^{4}$
Pu-241	$1.4 \cdot 10^{12}$	Cm-248	$2.2 \cdot 10^{7}$
Ra-226	$3.9 \cdot 10^{11}$		

Table D–14: Volume emplaced in the Morsleben repository (ERAM) according to individual waste producer groups

Waste producer group	Volume in m³
Nuclear power plants	23816
Decommissioned nuclear power plants	6528
Research institutions	2592
Nuclear industry	159
State collecting facilities	3090
Others	523
Reprocessing	45
Total	**36753**

Inventory of Material from Past Practices

In this report, the term “past practices” is understood as referring to installations belonging to the company Wismut AG[1] for uranium ore mining and refinement, situated in the German *Länder* of Saxony and Thuringia (cf. the remarks on Article 12 (ii)). However, the waste generated from these past practices is not classified as radioactive waste for the reasons outlined below. Consequently, an inventory of these materials is not included in this report.

According to Section 118 of the Radiation Protection Ordinance (StrlSchV) and Article 9, section 2 together with Appendix II, chapter XII, section III, nos. 2 and 3 of the German Reunification Act, the following regulations are to remain in force in the new Federal States of Germany with respect to the remediation of the legacy of past practices and the decommissioning and remediation of uranium mining and milling installations, provided radioactive substances, particularly radon decay products, are present:

- the GDR Ordinance on Nuclear Safety and Radiation Protection (*Verordnung über die Gewährleistung von Atomsicherheit und Strahlenschutz* - VOAS) of 11 October 1984 and its Implementing Regulation of 1984 (*Durchführungsbestimmung zur Regulation über die Gewährleistung von Atomsicherheit und Strahlenschutz - DB zur VOAS*) [1A-4] and
- the Order of 1980 on Radiation Protection in Relation to Slagheaps and Industrial Repositories (*Anordnung zur Gewährleistung des Strahlenschutzes bei Halden und industriellen Absetzanlagen und bei der Verwendung darin abgelagerter Materialien - HaldenAO*) [1A-4]

These regulations have the status of statutory ordinances promulgated on the basis of the Atomic Energy Act, with the exception of two areas, namely, the protection of occupationally exposed personnel (Section 118, para. 3 of the StrlSchV), and emission and immission monitoring (Section 118, para. 3 of the StrlSchV), both of which are subject to the regulations of the Radiation Protection Ordinance. This approach was necessary because the Radiation Protection Ordinance does not apply to the remediation of mining sites, or at least only under certain circumstances. The radiation protection principles laid down in the VOAS are based on the recommendations of the ICRP (ICRP 26 of 1977 [ICRP 77] and ICRP 32 of 1981 [ICRP 81]).

In order to categorise the material generated from past practices at uranium mines and other contaminated sites, recourse must be made to the definitions and exemption levels of the aforementioned regulations of the former GDR, given that they retain their validity. As such, the provisions of Section 2, para. 2 nos. 1 and 2 of the Atomic Energy Act, which state that the activity or concentration of activity of a substance may be disregarded if it falls below the exemption levels set out in Appendix III, tab. 1 col. 2 or 3 of the StrlSchV, do not apply in such cases.

The Annex to the VOAS defines the following two categories of residual materials containing radionuclides, depending on the level of activity concentration:

- radioactive releases (“radioactive substance which is released to the environment with waste water or air or disposed of in solid form and whose activity concentration exceeds the specified exemption criteria for radioactive releases”) and
- radioactive waste (“radioactive substance which cannot be reused or recycled for scientific, technical and economic reasons and which is disposed of in such a way that it is isolated from the environment and whose activity and activity concentration levels exceed the exemption criteria stipulated for radioactive waste”).

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1) AG = *Aktiengesellschaft*, joint-stock company

According to Section 28 of the Implementing Regulation for the VOAS [1A-4], the exemption level for solid radioactive releases is 0.2 Bq/g. For radioactive waste, the exemption levels are the same as those for radioactive material, i.e. either an exemption level for the activity concentration of 100 Bq/g (or 500 Bq/g in the case of solid, naturally radioactive material); or alternatively, the exemption levels for total activity listed in Annex 2 of the Implementing Regulation for the VOAS (e.g. 5000 kBq for U_{nat}, 5 kBq for Ra-226; – in the case of more than one nuclide, the summation formula given in Section 28, para. 1 of the Implementing Regulation for the VOAS should be used). In summary, heaps and tailings and other waste material from Wismut sites are not generally classified as radioactive wastes within the meaning of VOAS or the Implementing Regulation for the VOAS.

Article 32 2.

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

Overview

Within the context of Article 32 2. (v) of the Convention, the report should include details of a nuclear facility (excluding final repositories) if the operator of such a facility has applied for a licence for decommissioning under Section 7, para. 3 of the Atomic Energy Act (AtG) or if such a licence has been granted (cf. the remarks on Article 26). Within the meaning of this Convention, such facilities are classified as “in the process of being decommissioned”. Table D–15 provides an overview of those facilities in Germany which are currently in the process of decommissioning or which have already been fully removed. A complete list of facilities can be found in Annex L-(c), Table L–11 to Table L–15.

Over the past two decades, Germany has acquired considerable experience in the decommissioning and dismantling of nuclear installations. Many research reactors and all prototype nuclear power plants, as well as a few larger nuclear power plants and fuel cycle facilities, are currently at varying stages of decommissioning. Some facilities have been fully removed and the site has been cleared for reuse.

Table D–15: Overview of facilities in Germany which are currently in the process of decommissioning and which have been released from regulatory control

Type of facility	In the process of decommissioning	Fully removed or released from regulatory control
Reactors with electrical power generation (nuclear power plants, prototype reactors)	15 reactor units	2 reactor units
Research reactors ≥ 1 MW thermal power (incl. nuclear ship Otto Hahn)	7 reactors	-
Research reactors < 1 MW thermal power	5 reactors	18 reactors
Commercial fuel cycle facilities (primarily fuel element production and reprocessing)	4 facilities	2 facilities
Research and prototype fuel cycle facilities	-	3 facilities

Reactors with Electrical Power Generation

The 15 reactor units with electricity generation currently in the process of decommissioning as per 31 December 2001, include 8 prototype and demonstration facilities, as well as the nuclear power plants at Greifswald (KGR), Rheinsberg (KKR) and Mülheim-Kärlich (KMK). In addition, the nuclear power plants Niederaichbach (KKN) and the Heißdampfreaktor Kahl (HDR) have been fully dismantled and the sites have been cleared for non-nuclear use. The nuclear power plant at Stade (KKS) has announced final shut-down and subsequent decommissioning for 2003.

In future, further nuclear power plants will be shut down and decommissioned in accordance with Germany's phase-out of nuclear power as laid down in the Atomic Energy Act.

Research Reactors

Seven research reactors with a thermal powers of 1 MW or more were in various stages of decommissioning as of 31 December 2001. Of the 23 research reactors with a thermal powers of less than 1 MW which are no longer operational, including a number of zero output reactors for educational purposes, the majority have already been fully removed.

Fuel Cycle Facilities

Of the six commercially operated fuel cycle facilities currently in the process of decommissioning in Germany, five are fuel fabrication plants at Hanau and Karlstein, one of which has already been removed in full, whilst the sixth is the reprocessing plant WAK at Karlsruhe.

Additional non-commercial fuel cycle facilities located at research centres have also been fully dismantled.

Status of Selected Decommissioning Projects

Würgassen Nuclear Power Plant (KWW)

The Würgassen nuclear power plant (KWW) was one of the first commercially operated nuclear power plants in Germany. It had a boiling water reactor with an electrical output of 670 MWe and started operation in 1971. Cracks in the core shroud were discovered during maintenance work in 1994, the likes of which had already been observed in a similar form in plants in the USA, Sweden, South Korea and Switzerland. Safety analyses showed that these cracks had at no time affected the safe operation of the plant and that continued operation would have been possible for a limited period of time. However, a decision was made to decommission the plant in late May 1995, based on financial considerations.

Direct dismantling was chosen as the decommissioning variant. Decommissioning was separated into six phases, each of which was covered by an individual licence. This step-by-step approach was designed to shorten the length of time required until granting of the first licence and to optimise the subsequent procedure by preparing for subsequent stages at the same time as carrying out those stages which had already been licensed.

At present, the first five phases out of a total of six have been licensed.

1. The first licence to decommission KWW was issued in April 1997. It comprises the decommissioning and dismantling of various parts of the plant, primarily in the turbine hall and in the building which houses the independent residual heat removal system and the emergency scram system.
2. The dismantling of contaminated parts, mainly pipes and valves in various systems in the reactor building, began in January 1998.

3. The licence to dismantle the pressure suppression system and various mobile reactor components was granted in July 1999.
4. The licence for phases four and five was issued in September 2002. The reactor pressure vessel, the biological shield and the pressure suppression system are dismantled in phase four. In addition, the now empty building which houses the independent residual heat removal system is converted into an interim storage facility for radioactive waste.
5. During phase five, the remaining technical equipment will be removed from those buildings which are no longer required.
6. The demolition of the buildings and the recultivation of the site is scheduled for phase six. Some buildings may, however, be kept and re-used for industrial purposes.

Residual materials like metal scrap, building rubble etc. are generally decontaminated (if applicable) by means of abrasive blasting and are then subjected to a clearance procedure outlined in Section 29 of the Radiation Protection Ordinance (StrlSchV) which ends with a final measurement on which the clearance decision is based. Experience shows that most of this material achieves clearance; only a small percentage of the total mass requires treatment and disposal as radioactive waste.

In terms of the project schedule, dismantling and decontamination techniques used, and materials and waste management, the decommissioning of KWW can be regarded as typical of larger commercial nuclear power plants in Germany.

Greifswald Nuclear Power Plant (KGR)
Eight nuclear power plant units of Soviet design, each with an electrical output of 440 MWe, had been planned for the nuclear power plant complex at Lubmin near Greifswald (KGR). At the time of final shut-down in 1990, the first four units (type WWER-440/W-230) had been in commercial operation since the Seventies (unit 1 since 1974), whilst the fifth (type WWER-440/W-213) had been in trial operation for a few months when it was shut down in 1989. Units 6 to 8 were still under construction. Apart from the reactor units, the complex also comprises the “Interim Storage for Spent Fuel” (ZAB) and the “Central Active Workshop” (ZAW).

The decision to shut down all existing units and to halt commissioning of the remainder was taken on the basis of financial considerations, because under Federal atomic energy law, their continued operation would have required major structural conversions. Certain special features of the plant needed to be taken into account when preparing the concept for decommissioning and dismantling. Under Section 57 of the Atomic Energy Act (AtG) [1A-3], the operating licence from the former GDR remained valid until the decommissioning license was granted on 30 June 1995.

Dismantling of the entire complex is expected to take around 15 years, at which time it will be released from the purview of the Atomic Energy Act and the site will be cleared and reused for industrial or commercial purposes. The decision to opt for direct dismantling was based on a variety of factors, including technical and legal viability, the preservation of as many jobs as possible and hence also of available expert knowledge of the plant, and the avoidance of substantial rebuilding work to facilitate safe enclosure.

It would have been impossible to immediately remove all the spent fuel elements stored in the cooling ponds in the reactor buildings and in the interim storage facility for spent fuel prior to granting the decommissioning license. As a result, decommissioning began at a time when nuclear fuel and operational wastes were still present in the plant, which is an atypical situation for the decommissioning of power reactors.

For the most part, the decommissioning and dismantling of KGR is carried out by permanent staff from the operational period in order to make the best possible use of their expert technical and plant knowledge.

The project itself will be carried out over a number of licensing steps. The dismantling of components of unit 5 and in the monitored areas will be followed by the pilot dismantling of unit 5, the results of which will be used when dismantling units 1 and 2, and subsequently units 3 and 4. The dismantling of parts and components in unit 5 began in November 1995. Due to the low level of contamination in this unit and the swift progress made with the work, installation of the equipment for the remote-controlled dismantling of the reactors was able to begin as early as 1997. Meanwhile, dismantling of the equipment and components in unit 2 is also nearly complete, and the steam generator annulus has been emptied. Structural modifications are currently being made to the buildings in order to install the equipment for remote-controlled dismantling of the reactor. In unit 1, removal of the steam generators is complete, whilst in unit 4, there has been a comprehensive system shutdown and the logistics for dismantling are being prepared.

A vital part of the overall concept for decommissioning has been the construction of the Interim Storage Facility North (*Zwischenlager Nord*, ZLN) at the KGR site. The ZLN accepts spent fuel elements from the cooling ponds in the reactor buildings and from the ZAB, as well as from the nuclear power plant at Rheinsberg (KKR). In addition, the ZLN serves as an interim storage facility for radioactive wastes from KGR and KKR until they can be emplaced in a repository.

The ZLN also boasts conditioning and segmenting equipment and thus plays a key role in handling the large waste streams generated from the dismantling of KGR, because the segmenting of large components ex situ can be decoupled from the decommissioning progress in the plant itself. The material quantities generated at KGR are very different from those found in nuclear power plants of western design, because much larger amounts of material, particularly concrete, were used in the construction in relation to output. The total mass amounts to some 1.8 million tonnes, around 570000 t of which (metallic components, building rubble and building structures) will either have to be disposed of as radioactive waste, or else released following decontamination and clearance measurements. At present, it is not yet possible to quantify which percentages of this mass will be disposed of and released.

KGR is a very large decommissioning project which in its kind is unique in Germany. The project procedure used cannot be directly transferred to other German nuclear power plants scheduled for decommissioning in future. Nevertheless, valuable experience for the safe and efficient decommissioning of nuclear power plants with WWER reactors in the countries of Central and Eastern Europe and the CIS can be drawn from this project.

Karlsruhe Reprocessing Plant (WAK)

The Karlsruhe Reprocessing Plant (*Wiederaufarbeitungsanlage Karlsruhe*, WAK) was used for entry into the nuclear fuel cycle in Germany, and was operational from 1971 to 1990. In total, some 208 t of spent fuel from research and power reactors was reprocessed at WAK using the PUREX process (*P*lutonium *U*ranium *R*ecovery *Ex*traction). The plant was originally constructed with the aim of researching the basic principles for construction of an industrial-scale commercial reprocessing plant in Germany (like the WAW plant planned at Wackersdorf, whose construction had already begun) and developing a process management system. Following the decision in 1989 to halt the reprocessing of nuclear fuels in Germany and instead ship the waste to reprocessing plants in other European countries, the continued operation of WAK and the construction of WAW became superfluous.

WAK finally ceased operation at the end of 1990 and the first decommissioning license was granted. The reprocessed uranium and plutonium were used in the production of new fuel elements, whilst the separated highly active waste was intermediately stored at WAK. A key prerequisite for the decommissioning of WAK is the separation of decontamination and dismantling operations in the former process buildings from the handling and conditioning of the highly active liquid waste. For this purpose, the Karlsruhe Vitrification Plant (*Verglasungseinrichtung Karlsruhe*, VEK) was constructed at the WAK site, where highly active liquid waste is melted together with special glass and poured into stainless steel casks. The solidified glass safely contains the highly active waste. The welded containers are put into CASTOR® casks and held in interim storage until they can be emplaced in a repository for heat generating waste. It is envisaged that VEK will be shut down and dismantled once it has served its purpose for WAK.

Much of the dismantling work at WAK is carried out using remote-controlled tools because of the high dose rates. Before applying them at WAK itself, the manipulator systems and their handling are tested on full-scale test rigs of process cells. As far as possible, the dose rate in specific areas of the plant is also reduced by decontamination to levels which allow the use of manual segmenting techniques. Removal of the components will be followed by decontamination of the building structure and its subsequent clearance. Once it has been released from official control under the Atomic Energy Act, the WAK will be demolished conventionally. The whole decommissioning project is divided into several stages, some of which are carried out in parallel:

1. Deregulation: Shutdown of redundant process systems and/or adaptation to the reduced requirements. Licensing for this stage was granted and it has since been completed.
2. Initial dismantling activities in the process building, hands-on dismantling of process systems, shutdown of operations, and removal of plant components already decommissioned. Work on this step began in early 1996 and was finished in 1997.
3. Gradual dismantling of all equipment in the process building not related to HAWC storage and disposal with the aim of cancelling the controlled area. The remotely controlled dismantling of the process cells was finished at the end of 2001. During this time the laboratory for the analysis of high active waste was relocated. The separation of the HAWC-Reserve-Storage of the process building is nearly completed. Initially, the process cells are cleared primarily by remote control. Parallel to this, the laboratories are removed and the HAWC reserve store is decoupled from the process building. This is followed by dismantling of the auxiliary systems including the barriers, and decontamination of all rooms to an acceptable level for clearance so that the controlled area can be cancelled.
4. Deregulation of the HAWC storage facility and the VEK following the removal of HAWC.
5. Gradual dismantling of HAWC storage facilities and the VEK, followed by all auxiliary equipment; contamination and clearance measurement of all remaining rooms with the aim of cancelling the remaining controlled and radiation protection areas.
6. Demolition of the buildings after cancellation of the controlled and radiation protection areas, and recultivation of the site.

The decommissioning project is currently in an advanced stage of phase 3.

The presence of a broad spectrum of alpha emitting nuclides and fission products in varying proportions makes clearance of the material more difficult, because complex radiological characterisation and measurement procedures are needed.

The decommissioning and dismantling of WAK differs from the decommissioning of other fuel cycle installations in terms of overall scope, the effort involved, the need for remote controlled segmenting techniques, as well as materials and waste management. The specific plant design and procedural peculiarities are leading to an above-average input and hence cost for the WAK project. It is expected to be completed by the year 2010.

Section E. Legislative and Regulatory System

Article 18 (Implementing measures)

> *Article 18*
>
> *Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.*

Within the framework of its national law, the Federal Republic of Germany has already taken all the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention. The specific individual measures are described in connection with the comments on Article 19 of the Convention.

Article 19 (Legislative and regulatory framework)

> *Article 19*
>
> *1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.*

In accordance with its federal structure, the Constitution of the Federal Republic of Germany (Article 74 (1) 11a of the Basic Law [GG 49]) bestows upon the Federal Government the responsibility for legislation and regulation regarding "the production and utilisation of nuclear energy for peaceful purposes, the construction and operation of facilities serving such purposes, protection against hazards arising from the release of nuclear energy or ionising radiation, and the disposal of radioactive substances."

The Atomic Energy Act (AtG) [1A-3] entered into force on 23 December 1959 immediately after the Federal Republic of Germany had declared its intention to renounce the use of nuclear weapons. One of the aims of this Act was to promote the peaceful use of nuclear energy. The country's renouncement of nuclear weapons was also formalised by signing the Non Proliferation Treaty (NPT) on 28 November 1969.

In Germany, legislation and the implementation thereof must also take account of all binding requirements arising from European Union regulations. With respect to radiation protection, these include the EURATOM Basic Safety Standards [1F-18] for the protection of the health of workers and the general public against the dangers arising from ionising radiation issued on the basis of Articles 30 ff. of the EURATOM Treaty [1F-1]. In accordance with Articles 77 ff. of the EURATOM Treaty, any utilisation of ores, source material and special fissile material is subject to the surveillance of the European Atomic Energy Community. Regarding nuclear liability, the Federal Republic of Germany is also a contracting party of

- the Paris Convention on Third Party Liability in the Field of Nuclear Energy of 1960,
- the Brussels Supplementary Convention of 1963, and
- the Joint Protocol of 21 September 1988 Relating to the Application of the Vienna Convention and the Paris Convention.

Article 19

2. This legislative and regulatory framework shall provide for:

Article 19 2.

(i) the establishment of applicable national safety requirements and regulations for radiation safety;

Acts and Ordinances, in particular, the Atomic Energy Act

The Atomic Energy Act [1A-3] comprises the general national regulations for the safety of nuclear installations in Germany and constitutes the basis for the associated ordinances. Its purpose is to protect life, health and property against the hazards of nuclear energy and the detrimental effects of ionising radiation and, furthermore, to provide for the compensation for any damage and injuries incurred. It also serves the purpose of preventing the internal or external security of the Federal Republic of Germany from being endangered by the utilisation of nuclear energy. Another purpose of the Atomic Energy Act is to ensure that the Federal Republic of Germany meets its international obligations in the field of nuclear energy and radiation protection.

According to Article 87c of the Basic Law (GG), the execution of the administrative tasks under the terms of the Atomic Energy Act is performed by the *Länder* (Federal States), as agents of the Federal Government (federal executive administration) as stipulated in Section 24 of the Atomic Energy Act, unless provisions to the contrary are found in Sections 22 to 23a of the Atomic Energy Act. This means that in executing the Atomic Energy Act and its associated ordinances, the *Länder* are under the supervision of the Federal Government with regard to the lawfulness and expediency of their actions.

Interpretation of the term “state of the art in science and technology”, which is prescribed as the required yardstick in the Atomic Energy Ac, ensures that safety standards are adapted in line with modern developments.

The Atomic Energy Act, which regulates the safety of nuclear installations, is supplemented by the Precautionary Radiation Protection Act of 1986 [1A-5], which was prompted by the Chernobyl disaster, and specifies, *inter alia*, the tasks of environmental monitoring in case of events with significant radiological effects (cf. also the remarks on Articles 24 and 25 of the Convention).

A number of ordinances have also been promulgated in the field of nuclear energy on the basis of the Atomic Energy Act relating to the management of spent nuclear fuel and the management of radioactive wastes. The most important ones pertain to:

- radiation protection (Radiation Protection Ordinance) (StrlSchV) [1A-8],
- the licensing procedure (Nuclear Licensing Procedure Ordinance) (AtVfV) [1A-10],
- the transfer of radioactive wastes into or out of the territory of the Federal Republic of Germany (Nuclear Waste Transfer Ordinance) (AtAV) [1A-18],
- advance payments for the construction of radioactive waste disposal facilities (Waste Disposal Advance Payments Ordinance) (EndlagerVlV) [1A-13],
- the warranty of radiation protection with respect to waste dumps and industrial settling ponds and for the use of materials deposited therein (legislation of the former German Democratic Republic with continued validity under the Unification Treaty of 31 August 1990 (VOAS) [1A-4],
- provisions for sufficient coverage (Ordinance on the Financial Security Pursuant to the Atomic Energy Act) (AtDeckV) [1A-11] and

- the reporting of notifiable events (Ordinance on the Nuclear Safety Officer and Reporting of Accidents and Other Events) (AtSMVS) [1A-17].

The safety provisions and regulations of the Atomic Energy Act and associated ordinances are further concretised by general administrative provisions, guidelines, safety standards of the Nuclear Safety Standards Commission (KTA), recommendations by the Reactor Safety Commission (RSK) and the Commission on Radiological Protection (SSK), and conventional technical standards.

General Administrative Provisions

Beneath the level of acts and ordinances, general administrative provisions contain binding regulations governing the actions of the authorities. With respect to nuclear technology, there are a number of provisions governing:

- the calculation of radiation exposure during specified normal operation of nuclear power plants [2-1],
- radiation passports [2-2],
- environmental impact assessments [2-3], and
- environmental monitoring [2-4].

Guidelines

Guidelines are issued by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) following consultations with the *Länder* (Federal State) and generally by way of consensus with them. These guidelines are designed to provide a detailed specification of selected technical and administrative issues arising from the licensing and supervisory procedure (cf. the remarks on Article 20 of the Convention). They outline the BMU's opinion on general issues relating to nuclear safety and administrative practice, and provide orientation for the authorities of the *Länder* (Federal States) in their execution of the Atomic Energy Act. However, unlike general administrative provisions, these guidelines are not binding for the authorities of the *Länder* (Federal States). There are currently some 50 guidelines in the field of nuclear technology (see Appendix L-(f) [3-1] and following).

The following guidelines are of particular importance to the management of spent nuclear fuel and radioactive wastes:

- the Safety Guidelines for Dry Interim Storage of Irradiated Fuel Assemblies in Storage Casks [4-2],
- the Safety Criteria for the Permanent Storage of Radioactive Wastes in a Mine [3-13],
- the Guideline on the Monitoring of Emissions and Immissions Resulting from Nuclear Facilities [3-23],
- the Guideline on Control of Radioactive Wastes with Negligible Heat Production Not Delivered to a State Collecting Facility [3-59],
- the Guide to Decommissioning of Facilities under Section 7 of the Atomic Energy Act (AtG) [3-73],

Recommendations of the RSK and SSK

The recommendations of the Reactor Safety Commission (RSK) and the Commission on Radiological Protection (SSK) play an important role with respect to licensing and supervisory procedures. Both of these independent expert commissions advise the Federal Environment Ministry (BMU) on issues relating to nuclear safety and radiation protection. By appointing experts in different technical fields, it is intended that the full bandwidth of scientific knowledge should be reflected in these two bodies (cf. the remarks on Article 20 of the Convention).

The Reactor Safety Commission was founded in 1958 and advises the Federal Environment Ministry (BMU) on issues relating to nuclear safety and physical protection. The RSK is also involved in the advanced development of safety standards in nuclear installations. It normally consists of 12 members, who are generally appointed for a period of two years and should represent a full range of expertise in order to ensure that the BMU is properly advised. The members must guarantee competent and objective advice. In order to ensure well-balanced advice, the RSK should be staffed in such a way that the entire spectrum of opinions maintainable according to the state of the art in science and technology are represented.

The Commission on Radiological Protection (SSK) was founded in 1974 and gives recommendations to the Federal Environment Ministry (BMU) with regard to the protection of the population as well as employees in medical facilities, research, industry and nuclear installations against ionising and other radiation. Here too, the SSK's 14 members are generally appointed for a period of three years. The RSK and SSK submit their opinions to the Ministry in the form of recommendations which are prepared in subcommittees. Via publication in the Federal Gazette (*Bundesanzeiger*) these recommendations become part of the nuclear rules and their application is recommended by circulars of the BMU.

KTA Safety Standards

The Nuclear Safety Standards Commission (KTA), founded in 1972, formulates regulations containing detailed, concrete specifications of a technical nature. Such regulations are produced wherever "experience leads to a uniform opinion among experts from within the groups of manufacturers, construction companies, and licensees of nuclear installations, together with expert organisations and the authorities." Each of these groups is represented in the KTA. Regular reviews and amendment where necessary of adopted safety standards at intervals of no more than five years ensure that standards are adapted in line with the state of the art in science and technology. In themselves, KTA safety standards are not legally binding. However, by virtue of their process of origination and their high level of detail, their practical effect is wide-ranging. To date, the KTA has issued a total of 88 safety standards and 4 standard drafts (as of 06/2000); an additional 12 standard drafts are currently under preparation, and 12 safety standards are in the process of being revised. Most of these standards refer to nuclear power plants, although some also apply analogously to facilities for spent fuel and radioactive waste management.

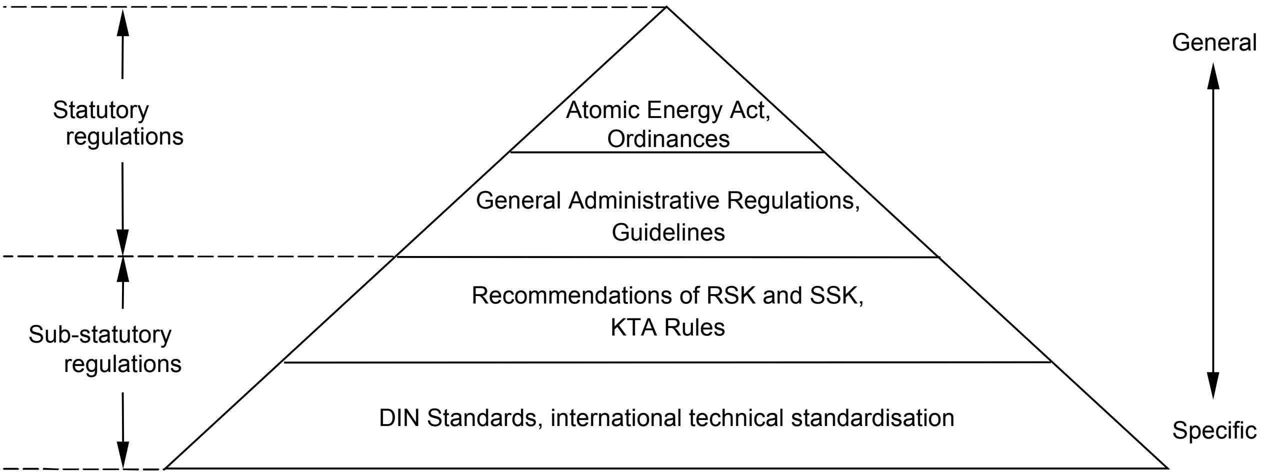
Quality assurance is a key issue, and one which is addressed in most of the safety standards. The term quality assurance as used in the KTA safety standards also encompasses the area of ageing, which is now treated as a separate issue at international level (cf. the remarks on Article 23 of the Convention).

Conventional Technical Standards

As is the case with the design and operation of all technical installations, conventional technical standards likewise apply, particularly the national standards of the German Institute for Standardisation (DIN) and the international standards of the ISO and IEC, provided these conventional standards reflect the state of the art in science and technology.

Overall Picture of Nuclear Rules and Regulations

Overall, German nuclear safety regulations may be hierarchically structured in the form of a pyramid, bearing in mind that technical regulations are only binding within the framework of interpreting the state of the art in science and technology (see above).



Nuclear regulations, with the exception of laws, ordinances and general administrative provisions, only have regulatory relevance by virtue of the legal requirement concerning the state of the art in science and technology. According to legal practice, it can be presumed that the nuclear rules and regulations accurately reflect the state of the art. Consequently, a verified scientific advancement will displace the application of a standard which has been rendered obsolete by said advancement without needing to suspend this standard. Thus, the dynamic improvement in safety requirements required by law is not bound by the formal development of standards.

In this report, reference will be made to the contents of the individual regulations when addressing the respective articles of the Convention. The Appendix entitled "Reference List of Nuclear Rules and Regulations" lists the current regulations applicable to nuclear installations in the aforementioned hierarchical order. All of the listed regulations are accessible to the public and are published in official publications of the Federal Government.

In essence, the structure and content of the safety provisions and regulations described herein were developed in the Seventies. Since then, they have been applied in all nuclear licensing and supervisory procedures and have been further developed, where necessary, in line with the state of the art in science and technology.

Other Legal Areas

When licensing nuclear installations, other legal requirements outside of the nuclear safety and radiation protection legislation must also be taken into account. In particular, these include:

- the Construction and Regional Planning Act (*Bau- und Raumordnungsgesetz*) [1B-2],
- the Federal Immission Control Act (*Bundes-Immissionsschutzgesetz*) [1B-3],
- the Federal Water Act (*Wasserhaushaltsgesetz*) [1B-5],
- the Federal Nature Conservation Act (*Bundesnaturschutzgesetz*) [1B-6],

- the Closed Substance Cycle and Waste Management Act (*Kreislaufwirtschafts- und Abfallgesetz*) [1B-13],
- the Environmental Impact Assessment Act (*Gesetz über die Umweltverträglichkeitsprüfung*) [1B-14].

The following is also important in the licensing procedure for repositories in deep geological formations:

- the Federal Mining Act (*Bundesberggesetz*) [1B-15].

Article 19 2.

(ii) a system of licensing of spent fuel and radioactive waste management activities;

With respect to protection against the hazards of radioactive materials and supervision of their utilisation, the Atomic Energy Act (AtG), as well as the Radiation Protection Ordinance (StrlSchV) in certain areas, requires that the construction and operation of nuclear installations is subject to regulatory licensing. The licensing requirement is stipulated in various provisions of the nuclear rules and regulations, depending on the type of installation and operation.

- Section 7 of the Atomic Energy Act (AtG): The management of spent nuclear fuel and radioactive wastes within stationary facilities for the production, handling, treatment or fission of nuclear fuel (e.g. in nuclear power plants) is normally covered by the licence granted to such facilities under Section 7 of the AtG, provided these management phases are directly related to the purpose of the facility. This applies in particular to the storage of spent fuel assemblies in the cooling pond of the reactor and to the treatment and interim storage of operational wastes. The pilot conditioning plant (PKA) at Gorleben, whose primary purpose is the treatment of spent fuel assemblies, likewise falls under the licensing requirement pursuant to Section 7 of the AtG. Licensing and supervision of the plant are carried out by the competent authority in the *Land (*Federal State) where the facility is located.
- Section 3 of the AtG: The import and export of nuclear fuel requires a permit under Section 3 of the AtG. A decision on the application is made by the Federal Office of Economics and Export Control (BAFA). The supervision of imports and exports is the responsibility of the Ministry of Finance or designated customs offices.
- Section 6 of the AtG: The storage of nuclear fuel, including spent fuel assemblies and radioactive wastes with significant contents of fissile material, requires a licence under Section 6 of the AtG. This refers, for example, to onsite interim storage facilities at the nuclear power plants and the central storage facilities for spent fuel containers at Gorleben and Ahaus. The licensing authority in this instance is the Federal Office for Radiation Protection (BfS), whilst supervision is performed by the competent authority of the respective *Land*.
- Section 9 of the AtG: The treatment, handling and other use of nuclear fuel outside of the facilities specified in Section 7 of the AtG, e.g. the handling of nuclear fuel on a laboratory scale for research purposes, requires an authorisation under Section 9 of the AtG. The respective *Land* is responsible for licensing and supervision of the facility.
- Section 9b of the AtG: The securing and disposal of radioactive wastes, which is the responsibility of the Federal Government according to the Atomic Energy Act, requires plan approval under Section 9b of the AtG. Plan approval is required for the repository site, a process which differs significantly from a licensing procedure under Sections 6 or 7 of the AtG in a number of respects. The applicant and subsequent operator is the Federal Office for

Radiation Protection. According to Section 9a of the AtG, the Federal Government may avail itself of the services of third parties or may transfer the execution of its tasks with the necessary sovereign competencies either wholly or partially to third parties, provided their proper fulfilment is guaranteed. These activities are subject to federal government supervision.

- Section 7 of the Radiation Protection Ordinance (StrlSchV): The handling of radioactive wastes requires a licence under Section 7 of the StrlSchV, unless already covered by one of the licences mentioned above. This category includes, in particular, the waste collecting facilities of the *Länder* (Federal States), and interim storage facilities for radioactive wastes at research centres and conditioning facilities. Licensing and supervision are the responsibility of the competent authorities of the *Länder* (Federal States).

Responsibilities relating to the licensing of nuclear installations are summarised in Table E–1

Table E–1: Responsibilities relating to the licensing and supervision of nuclear installations and activities in the Federal Republic of Germany

Material	**Activity**	**Facilities (examples)**	**Legal basis**	**Licensing**	**Supervision**
Nuclear fuel and radioactive waste containing fissile material	Treatment	PKA	Section 7 of the AtG	*Land* authority	*Land* authority
	Treatment or use	Activities outside of facilities governed by Section 7 of the AtG (e. g. laboratory-scale handling of nuclear fuel for research purposes)	Section 9 of the AtG	*Land* authority	*Land* authority
	Storage	Gorleben, Ahaus, on-site storage facilities, Siemens Hanau	Section 6 of the AtG	BfS	*Land* authority
	Import and export	--	Section 3 of the AtG	BAFA	Federal Government
Radioactive waste, without fissile material	Handling and storage	State collecting facilities, interim storage facilities, conditioning facilities	Section 7 of the StrlSchV 1)	*Land* authority (e. g. Trade Supervisory Office)	*Land* authority (e. g. Trade Supervisory Office)
Radioactive waste, general	Disposal	Repositories at Morsleben, Konrad	Section 9b of the AtG	*Land* authority	Federal Government

1) Unless the activity is already included in a licence under Sections 6, 7, 9 or 9b of the AtG.

Under the Atomic Energy Act, a licence may only be granted if the licensing conditions laid down in the corresponding section of the Act are met by the applicant. This includes, in particular, the required precautions against damage in accordance with the state of the art in science and technology.

Furthermore, it should be noted that any handling of radioactive material is subject to the binding provisions on supervision and protection outlined in the Radiation Protection Ordinance (StrlSchV). The StrlSchV includes regulations on the designation of responsible individuals by the licensee and the dose limits of radiation exposure for plant personnel and the general public during specified normal operation.

In order to ensure safety, licences for nuclear installations may be subject to certain conditions. The operation and ownership of, essential modifications to or decommissioning, of a nuclear installation without the necessary licence are offences liable to prosecution.

The licensing of nuclear installations (except for nuclear fuel storage facilities licensed by the BfS under Section 6 of the AtG) is the responsibility of the individual *Länder* (Federal States). In each of the *Länder,* ministries are the supreme authorities responsible for licensing. The Federal Government supervises implementation of the Atomic Energy Act and Radiological Protection Regulations (federal supervision). In particular, it has the right to issue binding directives on factual and legal issues in each individual case.

The actual details and procedure of licensing in accordance with Section 7 of the AtG are specified in the Nuclear Licensing Procedures Ordinance [1A-10]. It deals specifically with the application procedure, the submission of supporting documents, participation of the general public and the option of splitting the procedure into several stages (partial licences). Furthermore, it also addresses the assessment of environmental impacts [1B-14] and the consideration of other licensing requirements (e.g. non-radioactive emissions into the air or discharges into water). In the case of other nuclear licensing and plan approval procedures (according to Sections 6 or 9b of the AtG), the Nuclear Licensing Procedure Ordinance is applied analogously.

In accordance with Section 20 of the AtG, the competent authorities may consult authorised experts on technical or scientific matters related to regulatory licensing and supervision. Such experts have similar rights to the authorities with regard to the performance of inspections and requests for information. However, the authority is not bound by the assessments of their authorised experts.

The current nuclear liability regulations have translated the Paris Convention on Third Party Liability in the Field of Nuclear Energy [1E-11], amended by the Brussels Supplementary Convention [1E-12], into national law. Details of the required financial security are regulated by a statutory ordinance [1A-11]. In Germany, this means that licensees are generally required to take out liability insurance policies for a maximum financial sum specified in the individual nuclear licensing procedure.

The Nuclear Licensing Procedure as Illustrated by the Example of the Procedure According to Section 7 of the AtG

Licence Application

The licence application is submitted in written form to the competent licensing authority of the *Land* (Federal State) in which the nuclear installation is to be erected. The licence application is accompanied by documents containing all the relevant data required for evaluation purposes. The documents which should be enclosed with the application are listed in the Nuclear Licensing Procedures Ordinance [1A-10]. The required format is specified in guidelines. One important document is the safety analysis report which describes the plant, its operation and the related effects, including the effects of design basis accidents and the associated precautionary measures. It contains site plans and assembly drawings. In order to meet the prerequisites for licensing, further documents must also be submitted, including supplementary plans, drawings and descriptions.

Section 3 of the Nuclear Licensing Procedures Ordinance (AtVfV) defines the character and scope of the documents. It states that documents should be enclosed which allow verification of compliance with the licensing pre-requisites, in particular:

1. a safety report outlining the consequences of the project which are relevant to the decision on the application with regard to nuclear safety and radiation protection, and which will enable

third parties in particular to evaluate whether their rights could be violated by the facility or the impacts resulting from its operation. For this purpose, as far as this is necessary for a judgement of the project's admissibility, the safety report must include the following information:

a) a description of the facility and its operation including site plans and drawings;

b) a description and explanation of the concept (basic design features), the safety relevant design principles, and the function of the facility including its operational and safety systems;

c) an outline of the precautionary measures taken to meet the requirements of Section 7, para. 2, subpara. 3 and Section 7, para. 2a of the Atomic Energy Act (AtG), i.e. precautions against damage caused by the erection and operation of the facility in accordance with the state of the art in science and technology, including an explanation of the measures taken to prevent or mitigate the consequences of accidents not covered by the design of the facility and their tasks;

d) a description of the environment and its constituents;

e) information on the direct radiation and emission of radioactive substances associated with the facility and its operation, including releases from the facility in the case of accidents as defined in Sections 49 and 50 of the Radiation Protection Ordinance (StrlSchV) (design basis accidents);

f) a description of the impacts of direct radiation and the emission of radioactive substances referred to under e) on the protected entities outlined in Section 1a of the Nuclear Licensing Procedures Ordinance; these are human beings, animals and plants, soil, water, air, climate and landscape, cultural assets and other entities, including interactions with other substances;

2. complementary schemes, drawings and descriptions of the facility and its parts;

3. information on the provisions to protect the facility and its operation against malevolent acts or other illegal interference by third parties in accordance with Section 7, para. 2 subpara. 5 of the AtG;

4. information which will enable verification of the reliability and technical knowledge of the persons responsible for erection of the facility and for management and supervision of its operation;

5. information which will enable verification of the existence of the necessary knowledge of other persons involved in the operation of the facility in accordance with Section 7, para. 2, subpara. 2 of the AtG;

6. a list of all information relevant to the safety of the facility and its operation, the precautions taken for the control of accidents and damages, and a framework plan for the checks foreseen at safety-relevant parts of the facility (safety specifications);

7. proposals on precautions to comply with obligations on statutory liability for damages;

8. a description of the amounts of radioactive residues and information on precautions taken

   a) to avoid accumulation of radioactive residues;

   b) for the harmless utilisation of radioactive residues and removed or dismantled radioactive components;

c) for the orderly disposal of radioactive residues or removed radioactive components as radioactive waste, including their intended treatment, and for the anticipated storage of radioactive wastes until their disposal;

9. information on other environmental impacts of the project required for verification pursuant to Section 7, para. 2, subpara. 6 of the AtG for any approval decisions included in the licensing decision in individual cases, or for any decisions to be made by the licensing authority according to regulations on nature protection and landscape conservation. On this basis, it is necessary to verify that there are no overwhelming public interests, in particular with regard to environmental impacts, opposed to the choice of the site for the facility.

Furthermore, a short description of the planned facility, including information on the estimated consequences for the population and the environment, should be included with the licence application for the purpose of participation by the general public.

Examination of the Application

On the basis of the submitted documents, the licensing authority examines whether or not the licence prerequisites have been met. All federal, *Länder* (Federal States), local and other regional authorities whose jurisdiction is affected are to be involved in the licensing procedure, including in particular the authorities responsible for construction, water, regional planning and off-site disaster control. Given the broad scope of the safety issues to be examined, it is common practice to engage expert organisations to support the licensing authority in the evaluation and examination of the application documents. These organisations prepare expert reports outlining whether or not the requirements regarding nuclear safety and radiation protection have been met; they do not have any decision-making authority.

Within the framework of federal executive administration, the licensing authority of the individual *Land* (Federal State) may receive an opinion from the Federal Environment Ministry (BMU) from the point of view of federal supervision before the licence is granted. In performing its function of federal supervision, the BMU consults the Reactor Safety Commission, the Commission on Radiological Protection, and in many cases the *Gesellschaft für Anlagen- und Reaktorsicherheit,* for advice and technical support, and states its position on the draft licence to the competent licensing authority. The *Land* licensing authority must take the BMU’s position into account when making its decision.

Participation of the General Public

The licensing authority involves the general public in the licensing procedures, including in particular those citizens who might be affected by the planned facility. Details are regulated in the Nuclear Licensing Procedures Ordinance (AtVfV) [1A-10].

According to Section 4 of the AtVfV, the project is published in the official Publication Gazette and in local newspapers once the documents to be submitted are complete. According to Section 5 of the AtVfV, this announcement should include details of where and when the application will be available for public inspection, a request to submit any objections in writing to the competent authority within the specified period, and the date of the public hearing or reference to the fact that this date will be announced in future.

According to Section 6 of the AtVfV, the application, the safety report, a short description of the project, information on radioactive residues and other environmental impacts of the project, as described under points 8 and 9 above, are to be laid out for public inspection over a period of two months.

According to Section 7 of the AtVfV, objections may be raised in writing or for recording at the competent authorities.

The public hearing is regulated in Sections 8 to 13 of the AtVfV. At the hearing, any objections that have been duly raised are to be discussed insofar as this may be important for an examination of the licensing requirements. Any individuals who have raised objections are to be given the opportunity to explain them.

The licensing authority takes these objections into account when making its decision, and addresses them in the licence findings.

Environmental Impact Assessment

The Environmental Impact Assessment Act [1B-14], in conjunction with the Atomic Energy Act and Nuclear Licensing Procedures Ordinance based on it, regulate the need to conduct an environmental impact assessment and its procedure within the nuclear licensing procedure for the construction, operation and decommissioning of a nuclear installation to be licensed according to Section 7 of the Atomic Energy Act (AtG) or for an essential modification of the facility or its operation. The construction and operation of spent fuel management facilities are also subject to an environmental impact assessment according to Numbers 11.1 and 11.3 of Annex 1 of the Environmental Impact Assessment Act. According to Section 3, para. 2 of the Nuclear Licensing Procedures Ordinance, the following documents should therefore additionally be included with the application:

1. a summary of the main technical alternatives examined by the applicant, including the main reasons in favour of the preferred solution, insofar as this information may be significant when assessing the admissibility of the project under Section 7 of the Atomic Energy Act;
2. references to any difficulties which may have arisen when compiling information for the examination according to Section 1a, i.e. an examination of the environmental impact assessment requirements, in particular insofar as these difficulties are attributable to a lack of knowledge and methods of examination or technical loopholes.

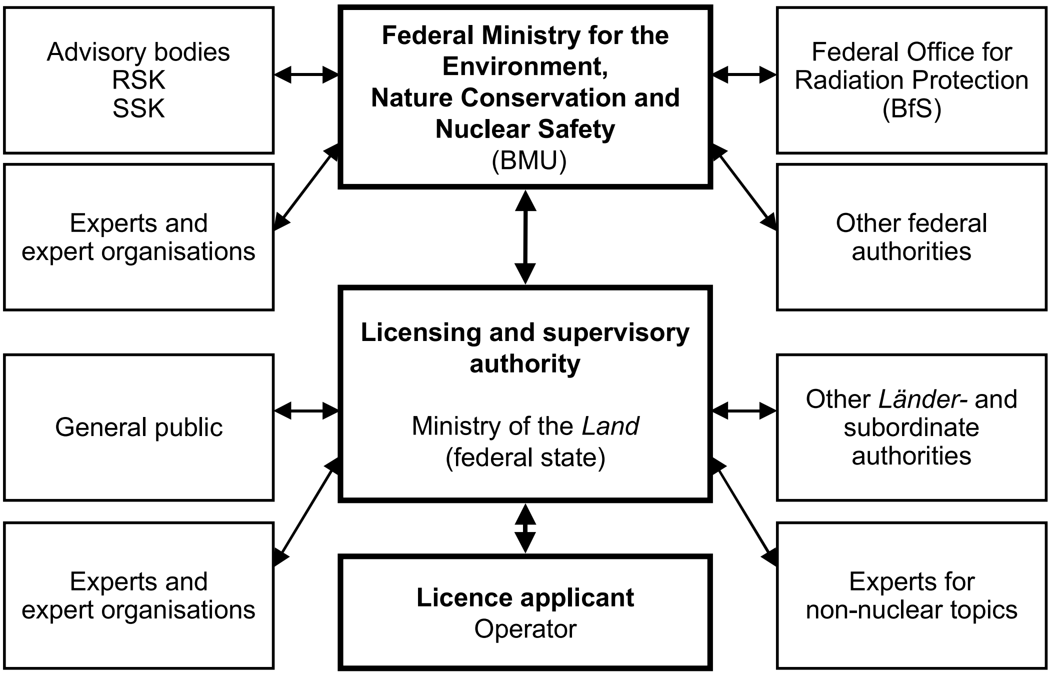
The competent authority performs a final evaluation of the environmental impacts which provides the basis for a decision on the project's admissibility with regard to effective environmental protection.

Licensing Decision

The final decision of the licensing authority is based on the entirety of application documents, evaluation reports by the authorised experts, the opinion of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the opinions of the authorities involved, and the findings from objections raised in the public hearing. One prerequisite for the legality of this decision is that all procedural requirements of the Nuclear Licensing Procedures Ordinance must have been observed. Action may be brought against the decision of the licensing authority before the administrative courts. In the case of a licence with immediate enforcement, a court action cannot prevent use being made of the licence.

The interaction between the various authorities and organisations involved in the nuclear licensing procedure and the participation of the general public is shown in Figure E–1.This creates a broad and differentiated decision-making basis which allows all interests to be taken into account when reaching a final decision.

Figure E–1: Parties involved in the nuclear licensing procedure (using the procedure according to Section 7 of the AtG as an example)



Plan Approval Procedure

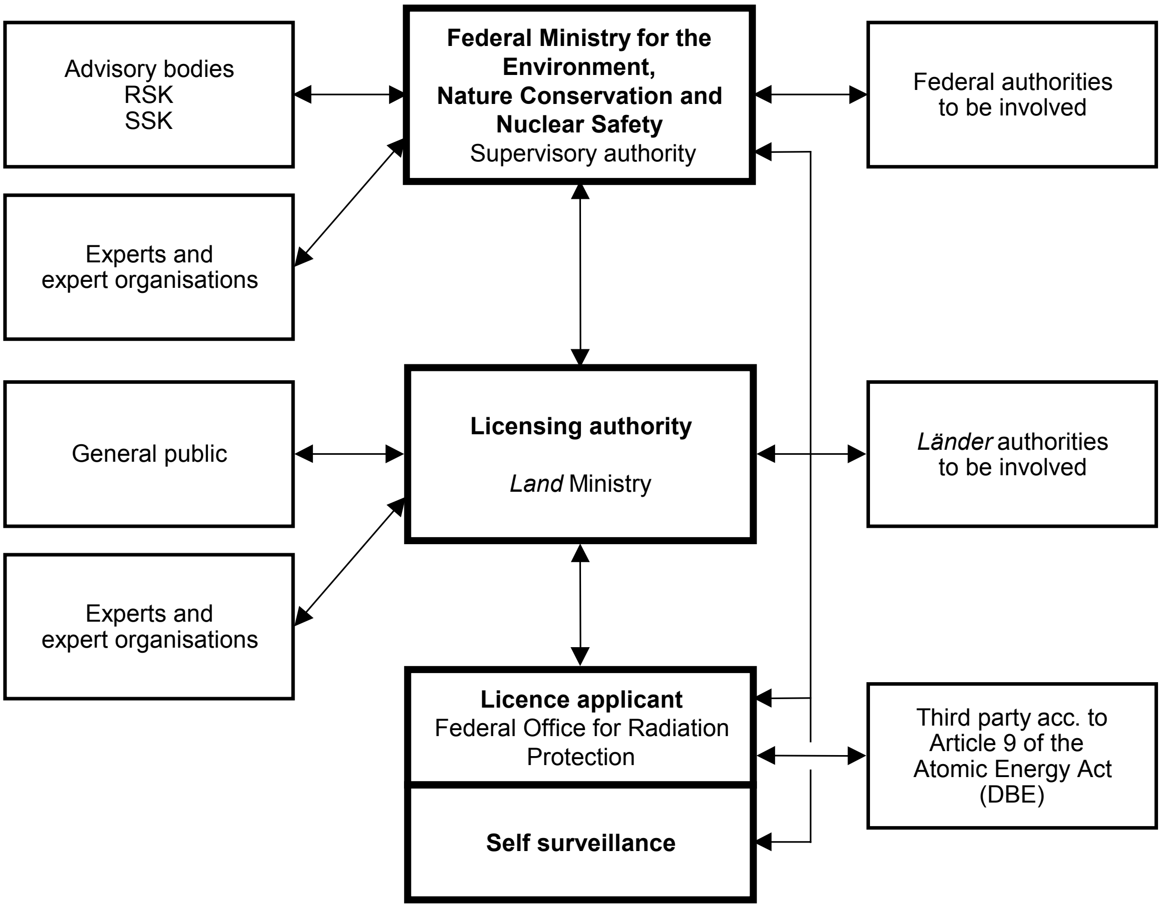
According to Section 23, para. 1, subpara. 2 of the Atomic Energy Act (AtG), the Federal Office for Radiation Protection (BfS) is responsible for the construction and operation of facilities for the safekeeping and disposal of radioactive wastes. According to Section 9a, para. 3 of the AtG, the BfS may employ the services of a third party to fulfil its tasks. The BfS exercises this option. The third party in question is the *Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe (DBE)* mbH (German Service Company for the Construction and Operation of Waste Repositories).

According to Section 9b of the AtG, the construction and operation of radioactive waste repositories requires a special licence known as plan approval (*Planfeststellung*). The requirements for this licence are very similar to those for a procedure under Section 7 of the AtG. The only exception is the requirement for liability provisions, which does not apply in the case of radioactive waste repositories since the state itself is responsible for such facilities. Section 13, para. 4 of the AtG explicitly states that the Federal Government and the *Länder* (Federal States) are not obliged to make liability provisions. Even if all requirements are met, the licensing authority is under no obligation to grant a licence. The licence must not be granted if unavoidable impairments to the common good are to be expected as a result of the construction or operation of the facility, or if other regulations under public law are opposed to the construction or operation of the facility. The licensing authority is also obliged to examine the justification of the project.

The main peculiarity of the plan approval procedure for radioactive waste repositories is that all legal areas are concentrated within one single procedure. As such, unlike other nuclear licensing procedures, the licence incorporates all the other licences required, e.g. under the terms of water legislation, building legislation or nature conservation legislation. According to Section 9b, para. 5, subpara. 3 of the AtG, there is only one exception, namely, that plan approval does not cover the legitimacy of the project under the provisions of mining law. This aspect must be decided by the competent authority. The participants in a plan approval procedure for radioactive waste repositories are shown in Figure E–2.

In exercising its tasks, the BfS performs a twofold function. On the one hand, the office is the applicant in a plan approval procedure according to Section 9b of the AtG; on the other, it performs a self-supervisory role during the construction and operation of a radioactive waste repository ("self-surveillance"). Self-surveillance is a separate organizational unit within the BfS and is subject to the direct supervision of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

Figure E–2: Participants in a plan approval procedure for a radioactive waste disposal facility



Article 19 2.

(iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence;

Prohibition of the operation of a spent fuel or radioactive waste management facility without a licence is derived from the requirements contained in the Penal Code, the Atomic Energy Act and the nuclear ordinances. These issues are addressed in greater detail in the section referring to Article 19 2. (v).

Article 19 2.

(iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;

Over their entire lifetime, from the start of construction to the end of decommissioning with the corresponding licenses, nuclear installations are subject to continuous regulatory supervision in accordance with the Atomic Energy Act (AtG) and related nuclear ordinances. As with the licensing procedure, a distinction is made between facilities that are to be licensed according to Sections 6, 7 or 9 of the Atomic Energy Act, and waste repositories that are subject to plan approval under Section 9b.

In the case of nuclear installations or the use of nuclear fuel licensed under Section 6, 7 or 9 of the AtG, the *Länder* (Federal States) in their supervisory role are acting on behalf of the Federal Government. In other words, the Federal Government has the right to issue binding directives on factual and legal issues in each individual case. As in the licensing procedure, the *Länder* are assisted by independent authorised experts.

As in licensing, the supreme objective of government supervision of nuclear installations is to protect the general public and the people engaged in these installations against the hazards associated with operation of the installation.

In particular, it is the duty of the supervisory authority to monitor

- compliance with the provisions, obligations and ancillary provisions imposed by the licensing notices,
- compliance with the requirements of the Atomic Energy Act, the nuclear ordinances and other nuclear safety standards and guidelines, and
- compliance with any supervisory orders issued.

To ensure safety, the supervisory authority also monitors the following with the aid of its authorised experts or by other authorities:

- compliance with operating procedures,
- the performance of in-service inspections of components and systems important to safety,
- the evaluation of reportable events,
- the implementation of modifications to the nuclear installation or its operation,
- radiation protection monitoring of the personnel,
- radiation protection monitoring in the vicinity of the nuclear installation,
- compliance with the authorised plant-specific limits for radioactive discharge,
- the measures taken against malevolent acts or other illegal interference by third parties,
- the trustworthiness and technical qualification and maintenance of the qualification of the responsible individuals, as well as of the knowledge of other staff working at the installation,
- the quality assurance measures

The Atomic Energy Act stipulates that the supervisory authority and the authorised experts consulted by it shall have access to the nuclear installation at any time, and are authorised to perform necessary examinations and to demand pertinent information.

Any events that are relevant to safety must be reported to the authorities [1A-17]. The regulations and procedures regarding reportable events and their evaluation are described in the comments on Article 9.

Contrary to the standard practice for nuclear installations licensed under Sections 6, 7 or 9 of the AtG, the regulations governing the supervision of radioactive waste repositories once a licence has been issued are somewhat different. In such cases, supervision is carried out by the Federal Government itself. To this end, an independent department – the so-called “Self-Surveillance” section – has been established within the Federal Office for Radiation Protection which performs government supervisory tasks on behalf of the Federal Government in co-operation with the responsible Federal Ministry (technical and legal supervision).

Article 19 2.

(v) the enforcement of applicable regulations and of the terms of the licences;

In order to enforce the valid provisions, the Penal Code [1B-1], the Atomic Energy Act [1A-3] and the nuclear ordinances contain sanctions in case of violations:

Criminal Offences

Any violation that is classed as a criminal offence is dealt with in the Penal Code. For example, anyone who:

- operates, otherwise holds, changes or decommissions a nuclear installation without the required licence,
- knowingly constructs a defective nuclear installation,
- handles nuclear fuel or waste containing nuclear fuel without the required licence,
- releases ionising radiation or causes nuclear fission processes that may cause damage to life and limb of other persons,
- procures or manufactures nuclear fuel, radioactive material or other equipment for himself with the intent of performing a criminal offence

is liable to imprisonment or fines.

Administrative Offences

The Atomic Energy Act and related ordinances deal with administrative offences and provide for the imposition of fines on the perpetrators. An administrative offence is deemed to have been committed by anyone who:

- erects a nuclear installation without a licence permit,
- acts in violation of a regulatory order or provision,
- handles radioactive material without a valid licence permit,
- as the ultimately responsible person fails to ensure compliance with the protective and surveillance regulations of the Radiation Protection Ordinance.

The Atomic Energy Act and related ordinances require that the individuals who are ultimately responsible for the handling of radioactive material, for the operation of nuclear installations or for their supervision should be named. A person committing an administrative offence is personally liable for a fine up to € 50000. A legally effective fine against a person may cast doubt on the personal trustworthiness that was a prerequisite for the licence and may therefore require the removal of such individuals from office (cf. the remarks on Article 21 of the Convention).

Enforcement by Regulatory Order, Particularly in Urgent Cases

In the case of non-compliance with legal provisions or the terms of the licence permit, and also in case of a suspected threat to the life, health or property of third parties, the competent nuclear licensing and supervisory authority is authorised by Section 19 of the AtG to decree,

- that protective measures must be applied and, if so, which ones,
- that radioactive material must be stored at a place prescribed by the authority, and
- that the handling of radioactive material, the construction and operation of nuclear installations must be interrupted or temporarily – or, in the absence or revocation of the licence, permanently - suspended.

Enforcement by Modification or Revocation of the Licence

Under certain conditions, stipulated in Section 17 of the AtG, the nuclear licensing and supervisory authority may retrospectively decree certain conditions in order to safeguard safety. If the nuclear installation poses a major hazard endangering the persons engaged at the plant or the general public, and if this hazard cannot be eliminated within a reasonable period of time by means of appropriate measures, then the licensing authority must revoke the issued licence. Revocation is also possible if certain prerequisites for the licence permit cease to be met at a later date, or if the licensee violates legal regulations or decisions by the authorities.

Article 19 2.

(vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

The management of radioactive residues is based on the polluter-pays principle. According to Section 9a, para. 1 of the AtG, the producers of radioactive residues are required to ensure the harmless recycling of the residues or of their orderly disposal as radioactive waste. This also means that the producers are responsible for the conditioning and interim storage of the radioactive residues.

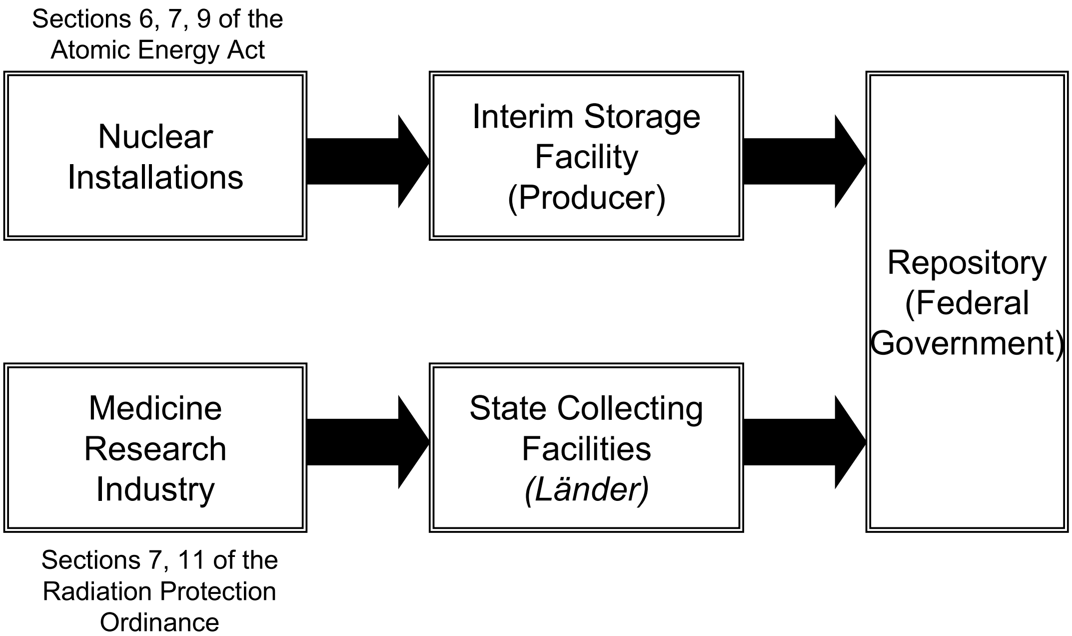
According to Section 9a, para. 2 of the AtG, as a general principle, anyone possessing radioactive waste must deliver it to a repository or to a State collecting facility (cf. Figure E–3).

According to Section 9a, para. 3 of the AtG, the *Länder* (Federal States) are required to establish State collecting facilities for the storage of radioactive wastes arising within their territory.

According to Section 9a, para. 3 of the AtG, the Federal Government is required to establish radioactive waste repositories. According to Section 23 of the AtG, the BfS is responsible for the planning, construction and operation of radioactive waste repositories and the supervision thereof. The other waste management facilities are supervised by the *Länder* within the frame of federal executive administration. The licences for waste management facilities, with the exception of interim storage facilities for nuclear fuel, are granted by the *Länder*. Interim storage facilities for nuclear fuel are licensed by the Federal Government (Federal Office for Radiation Protection).

The polluter-pays principle also applies to the financing of radioactive waste management activities. Though the Federal Government initially bears the necessary expenses for the planning and construction of radioactive waste disposal facilities, it refinances these costs by means of contributions or advance payments on contributions. The use of radioactive waste repositories and State collecting facilities is financed or refinanced by charges and fees that are payable by the waste producers.

Figure E–3: Obligation for the delivery of radioactive wastes (diagrammatic representation)



Article 20 (Regulatory body)

Article 20

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

Competence and authority

The Federal Republic of Germany is a federal state (Art. 20 (1) of the Basic Law (GG) [GG 49]), in which the individual *Länder* (Federal States) have the right of legislation except where specifically allocated to the Federal Government in the Basic Law (Art. 70 (1) of the GG). One special case concerns the area of competing legislation, where the *Länder* have the right of legislation provided the Federal State does not make use of its competence (Art. 72 (1) of the GG). Nuclear Legislation falls into this category (Art. 74 (1) no. 11a of the GG).

In adopting the Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards (Atomic Energy Act) on 23 December 1959, the Federal Government made use of this legislative competence. The Atomic Energy Act was comprehensively amended most recently by an Amending Act dated 19 July 2002.

Statutory ordinances have been issued on the basis of this Act with the approval of the *Bundesrat* (Federal Council).

Section 19 of the Atomic Energy Act (AtG) outlines the provisions of governmental supervision which is executed by the *Länder*, with the exception of the supervision of repositories.

Governmental supervision extends to the handling and trafficking of radioactive materials, the construction, operation and ownership of stationary facilities for the production, processing, treatment or fission of nuclear fuels or the reprocessing thereof, as well as facilities for the production of ionising radiation (facilities of the type mentioned in Sections 7 and 11 (1), no. 2 of the AtG), the handling and trafficking of facilities, instruments and devices which contain radioactive materials or generate ionising radiation (facilities, instruments and devices of the type mentioned in Section 11 (3)), the transportation of such materials, facilities, instruments and devices, the appropriated addition of radioactive materials and the activation of materials, insofar as requirements in this respect exist under the AtG or by virtue of an ordinance based on this act, as well as all work with ionising radiation of natural origin (according to Section 11 (1) no. 7 of the AtG).

The *Länder* implement the Atomic Energy Act in accordance with Section 24 (1), page 1 of the AtG in connection with Art. 87 c of the GG on behalf of the Federal Government. In accordance with Art. 85 (3) of the GG, the consequence of this is that responsibility for supervision of the *Länder* with respect to the lawfulness and appropriateness of measures taken lies with the Federal Government.

With regard to federal supervision, nuclear legislation and ordinances refer to the “minister responsible for nuclear safety and radiation protection” – the ministry. Section 9 of the Federal Government’s Rules of Procedure stipulates that the competencies of the ministries are assigned according to the Federal Chancellor’s authority on matters of general policy. In this instance, responsibility for nuclear safety and radiation protection has been assigned to the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

The third chapter of the Atomic Energy Act lists further regulatory bodies responsible for the implementation of and compliance with the provisions of this Act and related statutory ordinances:

- According to Section 22 of the AtG, the Federal Office of Economics and Export Control (BAFA) is responsible for licences involving transboundary transportation, while supervision is the responsibility of the Federal Ministry of Finances or the customs authorities designated by it.
- According to Section 23 of the AtG, the Federal Office for Radiation Protection (BfS) is responsible for the following with regard to the treatment of spent fuel elements and radioactive waste:
  - the construction and operation of federal facilities for the safekeeping and disposal of radioactive waste, the transfer of tasks to third parties by the Federal Government, and the supervision of such third parties,
  - the licensing of nuclear fuel storage outside of federal custody, where this does not constitute preparation or part of an activity subject to licensing under Sections 7 or 9 of the AtG, and the withdrawal or revocation of such licences,
  - decisions concerning exceptions from the duty to construct an interim storage facility on the site of a commercial nuclear power plant or in close proximity to it when an application for decommissioning has been filed (Section 9a (2) of the AtG).
- The Federal Office of Administration is responsible for decisions regarding preservation orders to secure sites for the disposal of radioactive waste (according to Section 9g of the AtG).

- Section 24 of the AtG regulates the competence of the *Länder* authorities:
  (1) The other administrative tasks under the Second Section and the resultant statutory ordinances are performed by the *Länder* on behalf of the Federal Government.
  (2) The supreme *Länder* authorities designated by the *Länder* governments are responsible for the licensing of nuclear facilities (pursuant to Sections 7, 7a and 9 of the AtG) and the withdrawal and revocation thereof, as well as for plan approval (pursuant to Section 9b of the AtG) and the reversal thereof as well as for the supervision of nuclear facilities (pursuant to Section 7 of the AtG) and the use of nuclear fuels outside these facilities. These authorities are usually supreme *Länder* authorities; licensing and supervision rest not inevitably in the same authority. In individual cases they may mandate subordinate authorities to carry out such tasks. The supreme *Länder* authority decides on any complaints against their orders. Insofar as provisions outside this Act confer supervisory authority upon other authorities, this competence shall remain unaffected.
  (3) For matters relating to the official duties of the Ministry of Defence, the competencies outlined in paragraphs 1 and 2 shall be carried out by said Ministry or other authorities designated by it in collaboration with the federal ministry responsible for nuclear safety and radiation protection.

Finances and Human Resources

All regulatory bodies are obliged to give an account of their human resources by drawing up job plans. The costs depend on the extent of the activities, i. e. different numbers of staff are employed in the various *Länder* depending on the number of nuclear facilities to be supervised there. The required funds for this purpose are established by the *Länder* parliaments and the *Bundestag* (Lower House of Parliament) in their respective budgets.

Article 20

2. Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation.

The economic use of nuclear energy lies in private hands and not in the public sector. Supervision, on the other hand, is a state function. Thus there is a separation of spheres of interest.

The only instance where a conflict of interests might be conceivable is in situations where financial promotion or the subsidising of scientific research occurs in the same government sector as the supervision of the corresponding nuclear facilities. At Federal Government level there is no such risk of a conflict of interests, since functions are assigned to different departments.

The planning and construction of repositories is a special case. This is a Federal Government task allocated to the Federal Office for Radiation Protection for execution. At the same time, however, the same federal office is also responsible for supervising this particular special type of nuclear facility. The licensing procedure takes the form of a so-called plan approval procedure, for which the supreme *Länder* authorities designated by the respective *Länder* governments are responsible. Federal supervision by the federal ministry responsible for nuclear safety takes the form of legal and expediency supervision. The corresponding *Länder* authorities decide on plan approval at their proper discretion. The supervision of construction and operation following plan approval is carried out by the “Self-surveillance” organisational unit within the BfS. This problem has been solved thanks to the organisational separation of the organisational units handling the projects and the “Self-surveillance” unit in charge of supervision. Although “Self-surveillance” is an organisational unit of the BfS, it is independent and not subject to directives. “Self-surveillance” is subject to the direct supervision of the BMU.

Section F. Other General Safety Provisions

Article 21 (Responsibility of the licence holder)

Article 21

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

The licensee has primary responsibility for the safety of a spent fuel management facility or a radioactive waste management facility. He may only be issued with a licence if he meets all the legal prerequisites for licensing. In the case of facilities licensed under Section 6 (e.g. interim storage facilities for spent fuel assemblies) or Section 7 (e.g. conditioning plants for spent fuel assemblies) of the Atomic Energy Act (AtG)[1A-3], one such prerequisite is the trustworthiness and technical qualification of the responsible individuals. Certified proof of this prerequisite and its acknowledgement by the authorities provide the basis for responsible performance under the licence.

In the case of companies with a number of board members authorised to represent it, the name of the ultimately responsible individual must be reported to the authority. This same person is also responsible for ensuring a functioning organisational structure and the deployment of qualified personnel at the facility.

The holder of a licence issued according to Section 31, para. 1 of the Radiation Protection Ordinance (StrlSchV) [1A-8] is responsible for the entire field of radiation protection. In addition, Section 31, para. 2 of the StrlSchV stipulates that radiation protection commissioners must be appointed for technical activities and monitoring of operation. Together with the radiation protection supervisor, these ensure due compliance with all protection and supervisory provisions of the Radiation Protection Ordinance (cf. the remarks on Article 24 of the Convention). According to Section 32, para. 5 of the StrlSchV, the radiation protection commissioners must not be hindered in the performance of their duties or suffer any disadvantages by virtue of their activities.

In order to better meet the specific requirements of nuclear safety at installations licensed under Section 7 of the AtG (e.g. plants for the conditioning of spent fuel assemblies), the additional position of nuclear safety officer has been created as part of the organisational structure of the plant [1A-17]. It is his responsibility to supervise nuclear safety issues in all areas of operation, and in doing so must act independently of the corporate interests of cost-effective plant operation. He should be involved in all activities concerning modifications, should assess any reportable events and the evaluation of operating data, and has the right to report directly and at any time to the plant manager.

When performing their tasks, the radiation protection commissioners, together with the nuclear safety officer, act independently from the company hierarchy.

The actual structure of the plant organisation is at the sole discretion of the licensee, provided it accommodates the requirements of the aforementioned responsible individuals and their duties, as well as the general requirements pertaining to quality assurance.

Any enforcement measures on the part of the competent authorities will always be directed in the first instance at the holder of the licence, with the objective that the ultimately responsible individuals will personally meet their respective obligations. If this is not the case, the authority can question the trustworthiness of such individuals, which is a prerequisite for granting the licence. Consequently, in such cases, any proceedings relating to an administrative or criminal offence will be directed at individual persons.

Article 21

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

If there is no licence holder or other party responsible for management or storage facilities for radioactive wastes not containing nuclear fuel, or such a person fails to meet his obligations, then responsibility for the safety of the facility or related activities shall rest with the competent *Land* (Federal State).

In cases where the licence holder is unable to meet his responsibility for safety with regard to the handling of nuclear fuels, or a corresponding licence does not exist, the Federal Government shall assume responsibility. Such a situation may also arise if nuclear fuels are found or in case of loss of authorisation on the part of the private licensee (e.g. in case of insolvency of the former owner or revocation of the licence). According to Section 5, para. 3 of the Atomic Energy Act (AtG), in such cases the Federal Government shall temporarily take the nuclear fuels into its charge (“government custody“) from the private licensee until the prerequisites for the handling of these materials according to the nuclear rules and regulations have been met once again. However, if otherwise provided by the supervisory authority under Section 19, para. 3 of the AtG, then this provision shall have priority over government custody.

According to Section 23, para. 1 of the AtG [1A-3], the BfS is responsible for the execution of government custody. The BfS may cause the private licensees to (re-)assume their responsibility with regard to the handling of nuclear fuels by issuing directives stipulating that nuclear fuels under government custody are to be returned to the charge of the private owners. This indicates that government custody of nuclear fuels is an exceptional case in the handling of these materials.

If radioactive substances are lost, found or misused, the *Land* concerned is likewise responsible for averting nuclear-specific danger. In severe cases, it is supported in this task by the BfS. This applies, in particular, to the finding of radioactive substances for which no other responsible party can be identified.

Article 22 (Human and financial resources)

Article 22

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

Article 22

(i) *qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;*

The Federal Republic of Germany has created a framework of minimum standards of education and knowledge for employees at nuclear facilities. According to Section 7, para. 2, no. 1 and 2 of the Atomic Energy Act (AtG) [1A-3], a licence for the erection or operation of a facility may only be granted if

- there are no known facts which could cast doubt on the reliability of the applicant and of the persons responsible for the erection and management of the installation and the supervision of its operation; and the persons responsible for the erection and management of the installation and the supervision of its operation have the required technical qualifications,

- measures have been taken to ensure that the persons otherwise engaged in operation of the installation have the necessary expert knowledge concerning the safe operation of the installation, the potential hazards, and the protective measures to be taken.

Section 30 of the Radiation Protection Ordinance (StrlSchV) contains regulations concerning the required scope of expert knowledge in the field of radiation protection as well as its acquisition and conservation.

The Ordinance on the Nuclear Safety Officer and on the Reporting of Accidents and Other Events (AtSMV) regulates the appointment of nuclear safety officers for nuclear installations licensed under Section 7, para. 1 of the AtG or for the storage of nuclear fuel licensed under section 6, para. 4 of the AtG.

In addition, there is the Guideline on Technical Qualification in Radiation Protection [3-40] which specifies the extent and required proof of the technical qualification of radiation protection supervisors and radiation protection commissioners.

Finally, there is the Guideline Relating to the Assurance of the Necessary Knowledge of Other Persons Engaged in the Operation of Nuclear Power Plants [3-27]. The contents of this guideline can be applied analogously to other nuclear installations.

Implementing the content of these regulations results in a hierarchy of responsibilities, each of which has varying requirements with respect to technical qualification and expert knowledge. There are four distinct groups with different requirements in terms of education and expert knowledge:

- Group 1: A completed education at a university, college or technical college in a relevant technical or mathematical-scientific area is required for radiation protection supervisors. They must have completed a course in radiation protection and have acquired the necessary knowledge in the nuclear regulatory framework. In addition, practical professional experience is also required. Persons in this group include the Head of the Radioactive Waste Repository Projects department at the Federal Office for Radiation Protection (BfS), the Head of the Waste Acceptance and Quality Control department, the manager of the repository and their respective deputies.
- Group 2: For other persons engaged in the operation of nuclear power plants and who must possess the necessary expert knowledge in radiation protection, the requirements for vocational training may be restricted according to their specific activities. However, the other requirements are the same as for the first group. Concerning a repository, examples of persons in this second group include the head of physical protection [3-57], the facility manager, the head of mining operation, the head of disposal of radioactive waste, the head of surface work, and the head of radiation protection.
- Group 3: Section 31, para. 4 of the Radiation Protection Ordinance (StrlSchV) stipulates that proof is required that radiation protection officers who are appointed by the radiation protection supervisor according to section 31, para. 2 of the StrlSchV possess the necessary technical qualification. Radiation protection officers are responsible for the management or supervision of measures designed to ensure compliance with the radiation protection principles and protective measures as laid down in the StrlSchV.
- Group 4: The fourth group comprises all “other” persons engaged in a nuclear facility. These persons are not obliged to have specific expertise in radiation protection, although they must have an adequate working knowledge thereof. They must have the level of education or training corresponding to their scope of duties and should acquire the necessary know-how by

instruction and training before starting work. Instruction serves to impart essential safety-related knowledge in the fields of work safety, fire prevention and radiation protection as well as plant-related knowledge. Training is held at the employee's workplace and takes place prior to commencing work.

The economic system in Germany precludes the compulsory allocation of employees, and ensures that working life is regulated by the principles of supply and demand. The same applies to the qualified personnel required in nuclear installations. The state, in the form of the Federal Government and the *Länder* (Federal States), provides educational facilities at which qualified vocational training is given. As a result of the freedom of movement within the EU, however, there has been an additional increase in the potential of appropriately trained applicants. The operators of nuclear installations, both state-owned and privately owned, for their part advertise for qualified staff.

There are appropriate training opportunities available in Germany at 17 universities and 11 technical colleges, for example in the field of nuclear and reactor technology at Aachen, Berlin, Essen, Karlsruhe, Munich and Zittau universities. Recognised radiation protection courses are held e.g. at FZK in Karlsruhe, at GSF in Munich and at Ilmenau Technical University. There are also recognised courses available in the non-governmental sector, e.g. at the various Chambers of Industry and Commerce and at *Haus der Technik* in Essen.

In order to ensure a sufficient number of qualified and well-educated staff for safety related work, existing knowledge must also be revised and updated.

- In relation to individuals, this is ensured by the regulations on recurring training in the field of radiation protection. Instruction courses are held every six months according to the "Guideline Relating to the Assurance of the Necessary Knowledge of Other Persons Engaged in the Operation of Nuclear Power Plants" [3-27]. For the other groups, instructions should be given at least every two or three years, respectively.
- The "Nuclear Competence Pool within the Framework of the HGF Nuclear Technology Research Pool" (*Kompetenzverbund Kerntechnik im Rahmen des HGF-Forschungsbereiches Energie*) has been founded in order to maintain an adequate level of know-how in the nuclear and radiation protection sector. It consists of the Karlsruhe Research Centre together with the universities of Karlsruhe and Stuttgart, the Jülich Research Centre together with the Aachen RWTH (university) and the Aachen/Jülich technical college, the Rossendorf Research Centre together with Dresden technical university and Zittau/Görlitz technical college and the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS mbH) together with Munich Technical University. This competence pool analyses the education and training situation and provides forecasts for the future, aimed at clarifying the current training situation.

Article 22

(ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning;

Publicly-operated nuclear facilities are supplied with the necessary funding by the competent body, which also extends to any safety-related issues associated with these plants. Private operators must supply the necessary financial resources themselves. In order to ensure that this occurs, they are subject to governmental supervision as defined in Section 19 of the Atomic Energy Act (AtG). Governmental supervision takes into account the requirements as set out in Section 7 of the AtG.

Under section 249 ff of the Commercial Code (HGB) [HGB 02], private operators are required to form reserves for the costs arising after final shut-down of the plants, i.e. for disposing of spent fuel assemblies or radioactive waste and for decommissioning and dismantling. In the case of publicly funded facilities, funds for decommissioning and dismantling are set aside in the current budget (cf. also the remarks on Article 26 relating to the decommissioning and dismantling of nuclear installations).

Article 22

(iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

Once a repository has been closed, its surveillance is a governmental task. Control measures performed by the authorities are essentially confined to passive measures. Active measures are not envisaged, given the design of the repository. In consequence, the anticipated costs are low. As these are government measures, their financing is guaranteed.

Article 23 (Quality assurance)

Article 23

Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

Quality Assurance

The concept and design of facilities for the conditioning, interim storage and disposal of spent fuel assemblies and radioactive wastes include constructive and administrative measures designed to protect the general public and workers against hazards arising from the release of radioactive substances and ionising radiation. The effectiveness of these measures is ensured within the framework of a quality assurance programme which also considers ageing phenomena and preventive maintenance. The requirements of KTA Nuclear Safety Standard 1401 (see enclosed list of KTA nuclear safety standards) regarding quality assurance are applied, wherever relevant. These include the principles of operational organisation, planning and design, production and construction including quality control, specified normal operation and incidents, documentation and archiving, as well as auditing of the quality assurance system itself. The nature and scope of measures to safeguard quality characteristics are oriented towards their significance for preventing damages caused by radiation exposure. The applicant or licensee is responsible for the planning, performance and control of the effectiveness of quality assurance. In this respect, an essential requirement of KTA Nuclear Safety Standard 1401 is the technical knowledge and qualification of the personnel.

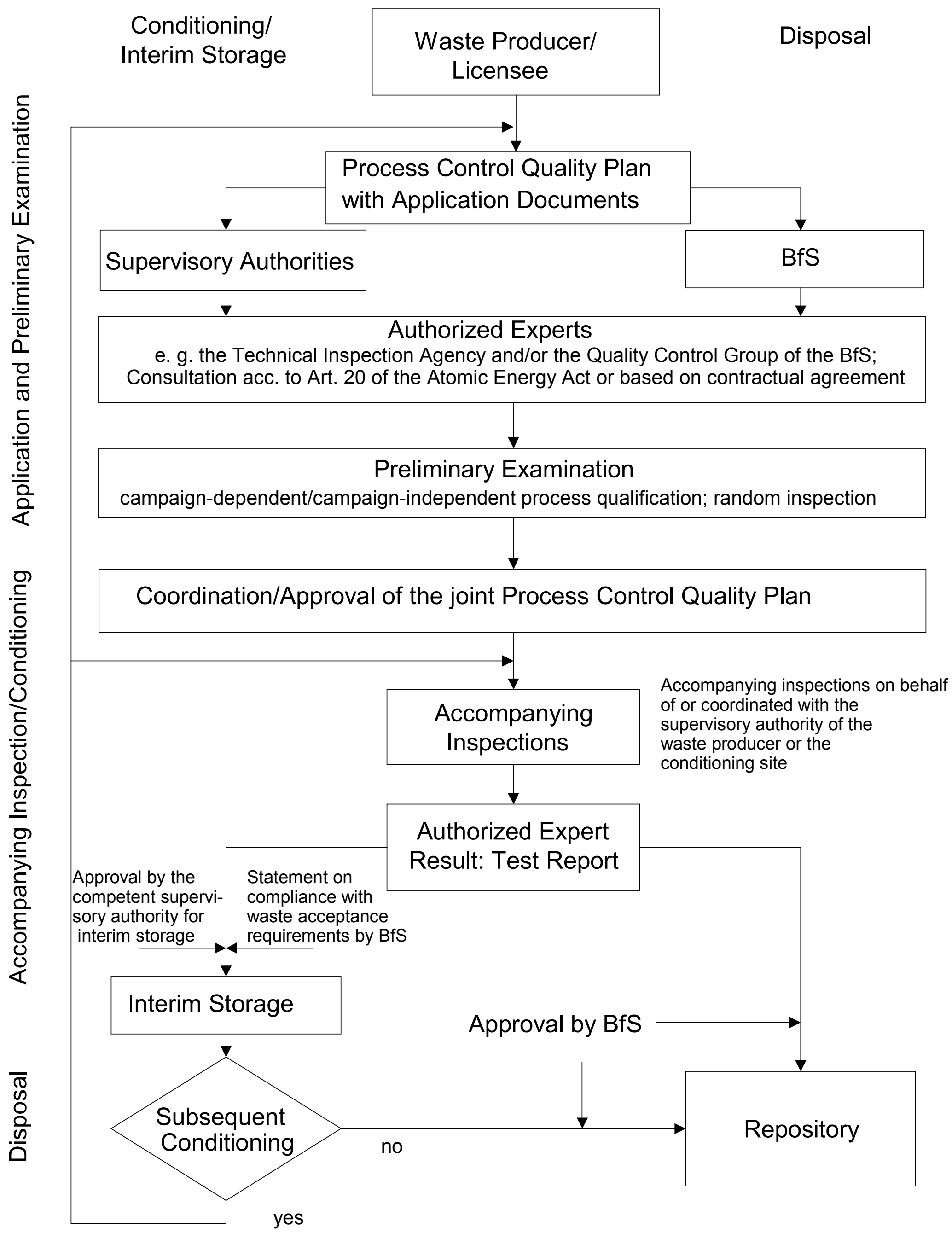
The quality assurance programme is addressed by the nuclear licensing procedure, which specifies the nature and scope of initial inspections and, where necessary, recurrent inspections by the supervisory authority. The supervisory authority monitors compliance with the quality assurance programme and related measures. In this role, it may consult experts. Moreover, it has access to the facility at all times in order to carry out the necessary inspections.

Waste Package Quality Control

Radioactive waste package quality control exists as a part of general quality assurance. Its task is to ensure compliance with waste acceptance requirements. These are the result of a site-specific safety analysis for the installation being licensed. The proof required in this respect pre-supposes a number of organisational and administrative regulations setting out the spheres of responsibility, tasks and activities of the parties involved. Within the scope of its responsibility for the operation of a repository, the BfS ensures that the waste acceptance requirements are met by examining waste packages and by qualification and accompanying control of conditioning measures.

Waste package quality control comprises regulations on quality assurance in the registration and conditioning of radioactive waste and in the production of waste containers, including the registration and documentation of the repository-relevant characteristics of the waste packages. Organisational and administrative regulations governing the spheres of responsibility, tasks and activities of the parties involved are laid down in a decision by the main committee of the *Länder* (Federal States) Committee for Nuclear Power, a body of the nuclear authorities, of 1/2 December 1994 (cf. Figure F–1) and through the agreements between the BfS and the waste producers. The supervisory authorities, the BfS, the appointed experts, the waste producers and the service companies acting on their behalf, as well as the operators of the interim storage facilities, are all involved in waste package quality control. The nature and extent of waste package quality control measures are determined depending on the conditioning technique, waste characteristics and repository requirements. The measures required in order to guarantee the safety of a repository for radioactive waste are laid down in the respective plant licence (plan approval notice).

Figure F–1: Quality control procedure for radioactive waste packages from nuclear facilities with respect to their conditioning, interim storage and disposal



Regulations on Waste Package Quality Control

Generally speaking, the BfS regulations on waste package quality control of radioactive waste with negligible heat generation admit two methods of proving that the waste acceptance requirements are met:

- Random sample testing of waste packages already produced, or
- Qualification of conditioning techniques and determination of accompanying control measures to be carried out.

Both alternatives were examined in detail and confirmed by the Environment Ministry of Lower Saxony as the competent licensing authority for the Konrad repository within the scope of the licensing procedure.

According to the Guideline on the Control of Radioactive Waste with Negligible Heat Generation that is Not Delivered to a State Collecting Facility (Waste Control Guideline) [3-59], qualified techniques are to be applied where possible for pre-treatment and conditioning. This requirement of the Guideline has been anchored in law in Section 74 of the amended version of the Radiation Protection Ordinance, accordingly the techniques have to get approval by the BfS.

The application of waste package quality control specific measures prior to emplacement of the waste packages in a repository has proven successful in practice during emplacement operations in the Morsleben repository for radioactive waste. Co-operation between all the institutions involved has likewise worked well. The experience thereby acquired does not suggest any reason for diverging from these techniques.

Article 24 (Operational radiation protection)

The legal foundation for radiation protection in the nuclear facilities listed above is the Radiation Protection Ordinance (StrlSchV) [1A-8]. The amendment of the StrlSchV was prompted by the need to translate EURATOM Directives 96/29/EURATOM [1F-18] and 97/43/EURATOM [EUR 97a] into German law. Essential aspects of the “Guideline on the Control of Radioactive Waste with Negligible Heat Generation that is Not Delivered to a State Collecting Facility” (*Directive zur Kontrolle radioaktiver Abfälle mit vernachlässigbarer Wärmeentwicklung, die nicht an eine Landessammelstelle abgeliefert werden*) [3-59] were likewise integrated into the new Ordinance. Furthermore, rules on the release from control of radioactive materials were also incorporated, together with a number of other regulations.

The Radiation Protection Ordinance is subordinate to the Atomic Energy Act (AtG) [1A-3], which outlines all the fundamental requirements to be observed in the construction and operation of nuclear facilities and the handling of radioactive materials.

International specifications which must be taken into account include the basic radiation protection standards of the IAEA [IAEA 96] and the recommendations of the ICRP.

Article 24

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

Article 24 1.

(i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;

(ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection;

Radiation Exposure of Persons Exposed to Radiation by Virtue of their Occupation

Persons exposed to radiation by virtue of their occupation are monitored for their radiation exposure by means of official and company dosimeters. According to the Radiation Protection Ordinance, they must not receive an effective dose of more than 20 mSv in a calendar year. In individual cases, up to 50 mSv in a year may be permitted, but the total dose over five years must not exceed 100 mSv. Limits are also specified for individual organ doses. Further details can be found in Table F–1.

Exceptions to these limits apply to persons under the age of 18, for whom the effective dose limit is only 1 mSv per year, and women of child-bearing age, who must not receive a cumulative dose of more than 2 mSv per month to the womb.

For a foetus whose mother may continue to work in the controlled area after her pregnancy has become known, the limit for the entire duration of the unborn child's presence in the controlled area is 1 mSv.

The maximum effective dose permitted over an individual's entire working life is 400 mSv.

The aforementioned dose limits may only be exceeded in exceptional cases for which official authorization must be obtained, e.g. in the case of rescue work or measures to avoid or remedy accidents. The rescue work and the ascertained body dose must be notified to the competent supervisory agency, since it is responsible for monitoring body doses.

For the limit values cited, Germany has adopted some of the specifications of the EURATOM Basic Safety Standards [1F-18], whilst others have been set at a lower level.

As a record of their radiation exposure, documentation is kept for all personnel listing both the results of the official dosimeters and those of any other dosimeters kept for operational reasons, or of dose calculations. The results of the official dosimetry are additionally evaluated centrally at the radiation protection registry of the Federal Office for Radiation Protection (BfS). Before commencing work in a controlled area, Category A persons exposed to radiation by virtue of their occupation must undergo a medical examination according to Section 54 of the Radiation Protection Ordinance; this must be repeated annually.

According to Section 6 of the StrlSchV, all unnecessary exposure to radiation by individuals, and all unnecessary contamination of people or the environment, must be avoided. Radiation exposure and contamination must be kept as low as possible, with due regard for the state of the art in science and technology and taking into account all the circumstances of each individual case. This conforms to the optimisation requirements of the ICRP. In keeping with the requirements of the StrlSchV, the protection of persons subject to on-site and off-site radiation exposure by virtue of their occupation has already been taken into account in the conceptual design of the nuclear facility, and must be ensured during its operation by appropriate protective measures and protective clothing, especially when handling open radioactive materials. Targeted work preparations designed to shorten and optimise the length of time spent in controlled areas likewise serve to minimise radiation exposure. The working conditions for pregnant women must be designed in such a way as to preclude on-site radiation exposure.

In addition, there are specially trained radiation protection officers in every nuclear facility, who are responsible for adherence to the staff radiation-protection provisions.

Radiation Exposure of the General Population

According to the Radiation Protection Ordinance, it is a general rule for all nuclear facilities that an effective dose of no more than 1 mSv per calendar year may result for individual members of the general public due to their operation. Adherence to this limit is taken into account at the planning stage of nuclear facilities. A summary of the limits for radiation exposure of the general public and of persons exposed to radiation by virtue of their profession is given in Table F–1.

Table F–1: Dose limits from the Radiation Protection Ordinance [1A-8]

§	Scope of application	Period	Limit [mSv]
	Design and operation of nuclear facilities		
46	Limitation of the radiation exposure of the general public		
	Effective dose: direct radiation from facilities, including discharges	Calendar year	1
	Organ dose for the lens of the eye	Calendar year	15
	Organ dose for the skin	Calendar year	50
47	Limitation of discharges during specified normal operation		
	Effective dose	Calendar year	0.3
	Organ dose for bone surfaces and skin	Calendar year	1.8
	Organ dose for gonads, womb, red bone marrow	Calendar year	0.3
	Organ dose for large intestine, lung, stomach, bladder, chest, liver, oesophagus, thyroid gland, and other organs or tissue not named above	Calendar year	0.9
49	Accident planning reference levels for the operation of nuclear power plants, for the near-site storage of irradiated fuel assemblies, and for Federal facilities for the secruring and disposal of radioactive wastes		
	Effective dose	Event	50
	Organ dose for thyroid gland and lens of the eye	Event	150
	Organ dose for skin, hands, forearms, feet, and ankles	Event	500
	Organ dose for gonads, womb, red bone marrow	Event	50
	Organ dose for bone surface	Event	300
	Organ dose for large intestine, lung, stomach, bladder, chest, liver, oesophagus, thyroid gland, and other organs or tissue not named above	Event	150

§	Scope of application	Period	Limit [mSv]
	Dose limits for persons exposed by virtue of their occupation		
55	Persons exposed by virtue of their occupation		
	Effective dose	Calendar year	20
	Organ dose for the lens of the eye	Calendar year	150
	Organ dose for skin, hands, forearms, feet, and ankles	Calendar year	500
	Organ dose for gonads, womb, and red bone marrow	Calendar year	50
	Organ dose for thyroid gland and bone surfaces	Calendar year	300
	Organ dose for large intestine, lung, stomach, bladder, chest, liver, oesophagus, thyroid gland, and other organs or tissue not named above	Calendar year	150
	Body dose for persons under the age of 18	Calendar year	1
	Apprentices aged 16-18, with the permission of the government agency	Calendar year	6
	Partial body dose for womb for women of child-bearing age	Month	2
	Unborn child	Pregnancy	1
56	Occupational lifetime dose, effective dose	Whole lifetime	400
58	Elimination of the consequences of hazardous incidents		
	(Category A only, after authorization by the authority)		
	Effective dose	Whole lifetime	100
	Organ dose for the lens of the eye	Whole lifetime	300
	Organ dose for skin, hands, forearms, feet and ankles	Whole lifetime	1000
59	Averting dangers to people	Calendar year	100
	(over 18 years of age only, no pregnant women)	Once a lifetime	250

If the nuclear facilities concerned are subject to licensing under Sections 6, 7 or 9 of the Atomic Energy Act, or authorized by means of the plan approval process under Section 9b of the AtG (such as the Pilot Conditioning Facility for spent fuel assemblies (PKA), the Karlsruhe Vitrification Plant (VEK) for fission products, the interim storage facilities for spent fuel assemblies and repositories), the radiation exposure for a reference person under worst-case assumptions must be determined at the planning stage, so as to verify compliance with the limits.

During operation of the nuclear facility, admissible discharges into air and water are specified by the competent government authority by limiting the concentrations and quantities of radioactivity, taking into account the pre-existing burden from other nuclear facilities and from earlier activities.

On-site interim storage facilities and temporary storage facilities for spent fuel assemblies do not generate any discharges of radioactive waste water, since any contaminated waste water e.g. from maintenance work on the containers which exceeds the exemption limits specified in Appendix VII, Part D of the Radiation Protection Ordinance is transferred to off-site facilities for disposal. Discharges into the air by releases from the storage casks are not anticipated, although release values have been applied for in order to allow for possible contamination of the cask surfaces, for example. In practice, however, discharges to the air are negligible, due to the leak-tightness criteria for storage casks and the existing rules for surface contamination on the outside of the casks. Radiation exposure due to direct irradiation by gamma and neutron radiation occurs in the immediate vicinity of the interim storage facilities and temporary storage facilities. In such cases, the aforementioned radiation-exposure limits for personnel and the general public must be taken into account.

Nuclear facilities not subject to licensing under Sections 6, 7 or 9 of the Atomic Energy Act, or to authorization by means of the plan approval process under Section 9b of the AtG, but which instead require a licence under Section 7 of the Radiation Protection Ordinance, such as conditioning facilities or interim storage facilities for radioactive wastes, do not require explicit specification of discharge values, provided the activity concentration levels listed in Appendix VII, Part D, of the StrlSchV are not exceeded on an annual average. Adherence to the requirements is regularly checked by the supervisory agency or appointed independent experts.

Article 24 1.

(iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.

In order to prevent incidents involving uncontrolled releases of radioactive materials, nuclear facilities must be planned and designed in such a way that the effects of such incidents remain limited.

Under Section 49 of the Radiation Protection Ordinance, the following requirements apply to the design of near-site interim and temporary storage facilities for spent fuel assemblies, and to government repositories for radioactive wastes:

- an effective dose of 50 mSv due to the release of radioactive substances into the environment (calculated across all exposure paths, as a 50-year consequential dose) must not be exceeded in a worst-case accident, and
- maximum organ doses for various organs must be taken into account, such as 150 mSv each for the eyes and the thyroid gland, and 300 mSv for bone surfaces.

For the aforementioned types of nuclear facilities, it is necessary to demonstrate during the licensing procedure that they are designed to avert accidents in accordance with these specifications.

For all other nuclear facilities, such as the central interim storage facilities for spent fuel assemblies at Gorleben and Ahaus, the interim storage facilities for radioactive wastes, and conditioning facilities for spent fuel assemblies and radioactive wastes, Section 59 of the StrlSchV applies. For such nuclear facilities, structural or engineering safeguards are specified by the licensing agency according to the hazard potential and the probability of accidents at a given plant. Over the next few years, the Federal Government intends to issue general administrative rules on accident prevent for the design of such nuclear installations. As a transitional measure according to Section 117, para. 18 of the StrlSchV, an effective dose of 50 mSv has been set for the worst-case accident.

Article 24

2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:

Article 24 2.

(i) to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and

(ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.

Discharges

According to Sections 46 to 48 of the Radiation Protection Ordinance, radioactive substances may not be released into the surrounding environment of a nuclear facility in an uncontrolled fashion.

Their operational discharge into water or air must be monitored, and registered according to specific type and activity. The discharge values specified by the competent authority in the plant's licence shall be observed with regard to concentration and quantity of radioactivity. As a rule, the actual values fall well below these limits.

The worst-case radiation exposure of an individual at the site is already used as the basis for determining the permissible discharge values at the planning stage of nuclear facilities. This may not exceed an effective dose of 0.3 mSv per calendar year for discharges in vent air and waste water respectively; maximum doses for specific organs are also specified. For nuclear facilities licensed under Sections 6, 7, 9, or 9b of the Atomic Energy Act for the treatment or storage of spent fuel assemblies or nuclear fuels, the peripheral conditions which should be assumed when specifying exposure paths are set out in a General Administrative Provision [2-1]. There is also a detailed guideline on the performance of emission and immission monitoring [3-23]. According to Section 47, para. 3 of the StrlSchV, the permitted discharge of radioactive substances in air and water is fixed by the competent authority by limiting the activity concentration or quantity.

For discharges from nuclear facilities that do not require a licence under the Atomic Energy Act, but are operated on the basis of a licence under Section 7, paragraph 1 of the Radiation Protection Ordinance, such as some of the conditioning facilities or interim storage facilities for wastes with negligible heat generation, the radioactivity concentrations listed in Appendix VII, Part D, of the StrlSchV must not be exceeded on annual average.

With respect to minimization of dose levels, please refer the remarks on Article 24 1.

Clearance of Material

Whilst reporting within the context of Article 24 2. (i) and (ii) is confined to discharges from the normal operation of nuclear facilities, at this point we would also mention the release from control of residual materials from nuclear facilities or other authorized handling of radioactive material (clearance), given its particular significance for waste and residual-materials management. However, clearance of solid or liquid materials in accordance with Section 29 of the Radiation Protection Ordinance (StrlSchV) does not constitute a discharge within the meaning of the definitions given in Section 3, para. 2, subpara. 2 of the StrlSchV, or within the meaning of Sections 47 and 48 of the StrlSchV.

Residual materials whose activities per unit mass or area – after decontamination, where applicable – are so low that they could at most lead to insignificant (trivial) doses in the general population are produced by nuclear facilities, especially during the decommissioning and demolition phases, and in particular from the operation of facilities for the treatment of radioactive substances and spent fuel assemblies. The criterion for triviality for each clearance option is defined in Section 29, para. 1 of the StrlSchV as an effective dose of 10 µSv per year for individual members of the general public, in conformity with the international rules and regulations.

Various clearance options are available for the release of materials from control. These are listed in Section 29, para. 2, subparas. 1 and 2 of the StrlSchV, in conjunction with the requirements outlined in Appendix IV of the StrlSchV. Important clearance options include the unrestricted clearance of all types of solid or liquid material, clearance for disposal (on a conventional landfill site or in a thermal waste-treatment plant), the clearance of rubble or soil for recycling (e.g. in road-building), the clearance of buildings for demolition or subsequent use, etc.

Clearance may only be given provided the protection of the public from radiation exposure is ensured. Therefore, the operator must prove that the materials cannot cause an effective dose of more than 10 µSv per year for individual members of the general public for each clearance option.

The operator can achieve this proof by adhering to the clearance levels specified in Appendix III, Table 1 of the StrlSchV, which take into account all relevant exposure scenarios for the individual. Operators also have the option of submitting so-called “individual proof” (*Einzelnachweis*) of adherence to the effective dose of 10 µSv/a for individual members of the general public. In such cases, the dose is determined on the basis of the specific peripheral conditions at the intended site of use, recycling or disposal.

Deliberate mixing or thinning of the materials in order to achieve clearance is not permitted.

Additionally, in future, due to the EURATOM Basic Safety Standards [1F-18], annual checks are to be conducted to ensure that a collective dose of 1 manSv for the population of Germany is not exceeded by the total clearances in any given year. This collective dose has not been introduced into the Radiation Protection Ordinance as a limit, and the respective competent authority cannot check whether it is adhered to for each individual ruling. However, it is necessary to determine a suitable procedure by which the collective dose can be estimated by the Federal government on the basis of the documents available at the competent agencies. It is envisaged that the estimated collective dose value will then be published by the Federal Ministry of the Environment in its annual reports on environmental radioactivity and exposure.

Article 24

3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

According to Section 51 of the Radiation Protection Ordinance, in the event of a radiological incident that is significant for safety, all necessary measures to minimise the dangers to people and the environment must be initiated at once. Furthermore, such an event must be notified immediately to the supervisory authority under the Atomic Energy Act and, if necessary, to the authority responsible for public safety and order, as well as to the authorities responsible for disaster control.

In radiological emergency situations, the competent authorities will notify potentially affected segments of the population without delay, and issue instructions on appropriate conduct. The remarks on Article 25 give an overview of the emergency measures to be taken depending on the hazard potential of the nuclear facility.

For nuclear facilities where radioactive substances are handled whose activity exceeds the exemption limits according to Appendix III, Table 1, of the StrlSchV by 10^7 times (in the case of open radioactive materials) or by 10^{10} times (in the case of enclosed radioactive materials), under Section 53 of the Ordinance the operator must also take on-site measures in preparation for damage limitation in case of safety-relevant events. These include in particular the provision of

- the necessary trained personnel for limiting and eliminating the dangers created on the plant site by accidents or incidents, and
- the necessary tools and equipment.

The readiness for action of the personnel and equipment must be proven to the competent authority.

The in-house procedure in case of an unplanned and uncontrolled release of radioactive substances into the environment must be specified in an operating manual (cf. the remarks on Article 9). The latter must include a fire protection code and an alarm code (KTA 1201; cf. list of

KTA rules in the appendix, to be applied analogously here). The fire protection code must specify preventive and aversive fire-protection measures. The alarm code should outline measures and rules of conduct for events posing a potential threat to staff and the surrounding area of the facility, as well as information on alarm drills and escape routes. Furthermore, the operating manual must outline the measures initiated automatically and those which must be initiated manually by the staff on shift in the case of an accident. It should also stipulate the criteria under which it is to be assumed that important safety functions are not being performed by the systems as designed, and on-site emergency protection measures must be invoked. The incidents defined in the licensing procedure must be addressed here.

Monitoring of Emissions and Immissions during Normal Operation and in Case of Accidents

According to Section 48 of the Radiation Protection Ordinance, discharges from nuclear facilities must be monitored, specified by activity and type, and this data reported to the competent authority at least once a year.

The supervisory authority responsible for the nuclear facility may order measures supplementary to monitoring, or in individual cases may exempt the facility operator from this reporting obligation, provided it can be adequately estimated that the limits will not be exceeded. This applies in particular to nuclear facilities licensed under Section 7 of the Radiation Protection Ordinance , such as some of the conditioning facilities and interim storage facilities for radioactive wastes.

For nuclear facilities requiring licensing or planning approval under Sections 6, 7, or 9b of the Atomic Energy Act, such as the Pilot Conditioning Facility for spent fuel assemblies (PKA), the Karlsruhe Vitrification Plant (VEK) for fission products, the interim storage facilities for spent fuel assemblies, several conditioning facilities for the treatment of nuclear fuels, and repository sites, the determination of meteorological and hydrological dispersion conditions may additionally be required.

It should be noted that the Pilot Conditioning Facility PKA, in which the spent fuel assemblies are dismantled and conditioned ready for emplacement, will only be used for the time being to repair damaged fuel-assembly casks until a suitable repository is complete. There is no need to consider radiation exposure here at present.

The “Guideline on Emission and Immissions Monitoring of Nuclear Facilities” (*Richtlinie zur Emissions- und Immissionsüberwachung kerntechnischer Anlagen = REI*) [3-23] contains specifications on the harmonization of monitoring and the performance thereof. The holder of the licence is responsible for monitoring and internal auditing. Independent institutions perform reference measurements on behalf of the competent supervisory authority.

Appendix C of this Guideline [3-23-2] contains supplementary specific regulations applicable to interim storage facilities for spent fuel assemblies and repository sites for radioactive wastes. It stipulates the following provisions:

Interim Storage Facilities for Spent Fuel Assemblies

Monitoring of emissions is not necessary if the leak-tightness and integrity of the fuel-assembly casks has been demonstrated and is monitored continuously. Monitoring of environmental immissions from dry-storage facilities must be regulated in such a way that the monitoring of contributions to total dosage from direct radiation of the nuclear facility is ensured.

Repository Site for Radioactive Wastes (Morsleben)

The principal considerations for emissions monitoring are substances such as Rn-222 and its decay products tritium and carbon-14, radioisotopes of thorium, uranium, and the transuranium isotopes, and fission and activation products. Specifically, the discharges in the exhaust air/waste air are monitored by means of continuous measurements, discontinuous or continuous sampling, and measurement in the bypass flow or from the exhaust air/waste air. The volumetric flow of the exhaust air/waste air must also be registered. Furthermore, the discharges in waste water during specified normal operation are also monitored.

Integrated Measurement and Information System

Besides the monitoring of emissions and immissions at the site of a nuclear facility, the Precautionary Radiation Protection Act (*Strahlenschutzvorsorgegesetz = StrVG*) [1A-5] also stipulates the Integrated Measurement and Information System for Monitoring Environmental Radioactivity (*IMIS*), which ensures comprehensive monitoring of environmental radioactivity throughout the territory of the Federal Republic of Germany. The respective responsibilities of the Federal Government and the *Länder* (Federal States) are specified under Sections 2 to 5 of this Act, together with the corresponding information system. The Implementing Regulation [2-4] for Section 10 of the Precautionary Radiation Protection Act governs the acquisition and transmission of data, whilst the two parts of the “Guideline on the Monitoring of Environmental Radioactivity in accordance with the Precautionary Radiation Protection Act” (*Richtlinie für die Überwachung der Radioaktivität in der Umwelt nach dem Strahlenschutzvorsorgegesetz*) [3-69] and [3-69-2], which were adopted by a committee of government agencies responsible for administering the Atomic Energy Act, regulate its precise implementation; they distinguish between a routine measurement schedule during normal operation, and an intensive measurement schedule in the event of an incident.

Comparative measurements and analyses are performed, and sampling, analysis, and measurement techniques are developed uniformly throughout the country. The data from emissions and immisions monitoring is grouped and documented. The government agencies responsible for this are:

- *Deutscher Wetterdienst* (German National Meteorological Service),
- *Bundesanstalt für Gewässerkunde* (Federal Institute for Hydrology),
- *Bundesamt für Seeschifffahrt und Hydrographie* (Federal Board of Shipping and Hydrography),
- *Bundesanstalt für Milchforschung* (Federal Dairy Research Centre),
- *Bundesforschungsanstalt für Fischerei* (Federal Research Centre for Fisheries),
- *Bundesamt für Strahlenschutz* (Federal Office for Radiation Protection).

The IMIS comprises more than 2000 stationary measurement stations for monitoring the local gamma dose rate and the activity concentration in the air, precipitation, and the aqueous environment. In addition, the radioactivity in food, fodder, drinking water, as well as in residual substances and waste waters, is determined continuously. Centralized data logging is performed at the Federal Central Station for Monitoring Environmental Radioactivity (*Zentralstelle des Bundes zur Überwachung der Umweltradioaktivität*) at the Federal Office for Radiation Protection in Neuherberg. The Federal Environment Ministry evaluates the data with the support of the Station. If threshold values are exceeded, the Ministry can issue an alarm; the governments of the *Länder* (Federal States) are alerted parallel to this by the IMIS.

Article 25 (Emergency preparedness)

Article 25

1. *Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.*

General Aspects

In Germany, a concept of nuclear emergency preparedness has been established which is naturally geared primarily around nuclear power plants. In principle, these rules are applicable to any nuclear facility; however, the effort required may be reduced for the nuclear facilities under consideration here, because their hazard potential is substantially lower in some cases.

The overall organization of emergency preparedness is governed by co-operation between the Federal Government and the governments of the *Länder* (Federal States), regional government agencies, the police, *Technisches Hilfswerk* (the governmental disaster relief organization), fire fighters, hospitals, and the operator of the nuclear facility. While the operator is responsible for on-site emergency preparedness, off-site emergency preparedness outside the facility is the responsibility of the *Länder* authorities (as part of disaster control). Temporally and geographically limited disaster-control measures are co-ordinated and performed by the *Länder* authorities, the regional government agencies, and in particular the management of the disaster-control services. This requires a precise knowledge of the state of the facility and an evaluation of the radiological situation and the situation in the areas affected.

The task of the Federal government and its competent ministries is to harmonise and, if necessary, co-ordinate the disaster-control efforts between *Länder*, and to initiate protective measures for the population as part of radiation-protection preparedness, such as measures regulating the consumption of foods or spending time out of doors.

Under Section 53 of the Radiation Protection Ordinance [1A-8], no special emergency preparedness measures are required for a nuclear facility if the activity of the radioactive substances handled there does not exceed certain limits. These limits are:

1. 10^7 times the exemption limits for activity according to Appendix III, Table 1, column 2 of the StrlSchV in the case of open radioactive materials,
2. 10^{10} times these exemption limits in the case of enclosed radioactive materials.

In principle, therefore, some of the nuclear facilities for the management of radioactive waste do not require emergency preparedness planning at all, since the possibility of safety-relevant events can be excluded. These are usually facilities subject to licensing under Section 7 of the Radiation Protection Ordinance.

Responsibilities of the governments of the *Länder* (Federal States)

It is the task of the competent government agency in a given *Land* (Federal State) to specify the nature and scope of emergency preparedness, taking into account the specific requirements of the respective nuclear facility. The criteria for the nature and scope of emergency planning are determined in particular by the radioactive inventory of the nuclear facility and the likelihood of an accident or hazardous incident occurring.

In the individual *Länder*, either a medium-level or a lower-level agency is responsible for disaster control. In accordance with the State Disaster Control Act (*Katastrophenschutzgesetz*) of that particular *Land*, alarm and action plans must be drafted and updated by the agency responsible to serve as off-site emergency plans for those nuclear facilities within its jurisdiction for which a safety report is required according to Article 9 of EU Directive 96/82/EC on the Control of Major-Accident Hazards Involving Dangerous Substances (*Official Journal of the EC*, 1997, No. L10, p. 13). The off-site emergency plans should specify all measures scheduled by the competent disaster-control authority in the case of accidents or hazardous incidents in the corresponding facility.

Taking into consideration the safety report, the on-site emergency plan, and other information from the operator, as well as the exchange of views with the competent supervisory authority for the nuclear facility, the disaster-control agency may decide that it is not necessary to draw up an off-site emergency plan. This waiving of off-site emergency planning must be justified in detail by the agency. In such cases, potential accidents are covered by the measures for general disaster control which must be planned regardless of the hazard potential of specific facilities.

If an off-site emergency plan is drafted for a nuclear facility, it must be updated continuously, and reviewed at regular intervals. Disaster-control exercises to check the accuracy of such emergency plans must performed at intervals to be specified by the competent agency.

The central interim storage facilities for spent fuel assemblies in Ahaus and Gorleben, the North Interim Storage Facility (*Zwischenlager Nord*), and the HTR fuel-assembly interim storage facility in Jülich are not subject to any special nuclear emergency preparedness planning, despite the fact that their radioactivity inventories exceed the limits given in Section 53 of the Radiation Protection Ordinance. Since the individual fuel-assembly casks are already designed to withstand external impacts, a safety-related event involving releases that would necessitate emergency protection measures is highly improbable, if not inconceivable. Disaster control falls under the general disaster-control planning of the *Länder* agencies. The situation at the Interim Storage Facility for Spent Fuel (*ZAB*) in Greifswald is somewhat different at present. Since this facility is not safeguarded against an aircraft crash, even though its radioactive potential is high, and (unlike dry interim storage in casks) there is no further containment of the fuel assemblies apart from the building, the disaster-control agency of the Ostvorpommern (Eastern Upper Pomerania) district responsible has drawn up a “Special Disaster Prevention Calendar” (*Sonderkatastrophenabwehr-kalender*), which can be considered equivalent to an off-site emergency preparedness plan.

In principle, the same applies to on-site interim storage facilities at nuclear power plants as to the central interim storage facilities for spent fuel assemblies. However, these facilities are already covered by the extensive emergency preparedness plans of the nuclear power plants.

The Pilot Conditioning Facility for spent fuel assemblies in Gorleben will not have special nuclear emergency preparedness plans if it becomes operational. The operating section of the facility is in a bunker and safeguarded against external impacts. There is no sufficient probability of other accidents of a relevant scope, due to the handling of sealed fuel rods.

The situation is somewhat different at nuclear facilities for the management of highly radioactive wastes, such as the one sited in the grounds of the fuel reprocessing plant in the Karlsruhe Nuclear Research Centre (WAK). This still contains more than 60 m³ of highly radioactive solutions of fission products in stainless-steel tanks, which are due to be solidified into glass logs at the Karlsruhe Vitrification Plant, which is not yet operational. Emergency preparedness plans exist for this facility in accordance with the regulatory specifications, and were drawn up in collaboration with the European Institute for Transuranic Elements (ITU).

Also located in the grounds of the Karlsruhe Research Centre are the facilities for conditioning wastes with negligible heat generation and an extensive on-site interim storage facility for such wastes, belonging to the Decontamination Plants Division (*Hauptabteilung Dekontaminations-betriebe = HDB*). However, the competent authorities, the Karlsruhe District Commissioner (*Regierungspräsidium Karlsruhe*) and the Baden-Württemberg State Ministry of the Environment, determined jointly in 1997-98 that all facilities of the Karlsruhe Nuclear Research Centre, including the Decontamination Plants Division (with the exception of the Karlsruhe Reprocessing Plant and the Institute for Transuranic Elements – see below) were to be exempt from off-site emergency preparedness planning.

Nor are there any specific emergency plans available for the Morsleben repository site, in view of the safety-relevant events conceivable there.

Table F–2 gives an overview of the specific emergency preparedness and disaster control measures for the individual nuclear facilities under consideration.

Table F–2: Off-site emergency-preparedness planning for facilities for the treatment of spent fuel assemblies and nuclear facilities for the management of radioactive waste

Nuclear facility	Off-site emergency-preparedness planning
Central interim storage facility for spent fuel assemblies for dry interim storage in casks	There is no need for an off-site emergency-preparedness plan. Covered by general disaster-control planning
Wet storage facility for spent fuel in Greifswald (ZAB)	Off-site emergency-preparedness plan exists.
On-site interim storage facilities for spent fuel assemblies	Off-site emergency-preparedness plan not necessary, but covered by emergency preparedness of the nuclear power plants nevertheless.
Karlsruhe Decontamination Plants Division	Exempt from off-site official emergency-preparedness planning since 1997-98
Karlsruhe Fuel Reprocessing Plant (storage of highly active solution of fission products)	Joint off-site emergency-preparedness plans exist with the European Institute for Transuranic Elements.
Interim storage facilities for radioactive wastes	There is no need for an off-site emergency-preparedness plan. Covered by general disaster-control planning
Morsleben repository site for radioactive wastes	There is felt to be no need for an off-site emergency-preparedness plan. Covered by general disaster-control planning

Measures

In October 1999, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety issued a catalogue of measures entitled “Overview of measures for the mitigation of radiological exposure following incidents or accidents with non-negligible radiological consequences“ [BMU 99] applicable to disaster control measures and to action under the Precautionary Radiation Protection Act (StrVG) [1A-5].

As part of emergency preparedness, disaster-control and radiation prevention measures may be initiated if necessary when the alarm is raised. In this respect, guideline [3-15]

1. provides framework recommendations for disaster control in the vicinity of nuclear facilities, and
2. specifies radiological foundations for decision-making to determine which measures should be taken to protect the population.

When specifying the radiological foundations for the recommendation of radiation prevention measures in [3-15], fixed numerical values for recommended intervention levels have been adopted, based on the recommendations in publications No. 63 and No. 40 of the ICRP ([ICRP 93] and [ICRP 84]) and the International Basic Safety Standards [IAEA 96], which are designed to facilitate decision-making, at least at the start of measures, and which can be adjusted later on if necessary. This is consistent with the approach adopted by the European Commission.

In accordance with the provisions of EU Directive 89/618 EURATOM [1F-29], section 51, para. 2 of the Radiation Protection Ordinance specifies that the affected population must be informed without delay of a radiological emergency situation and any special conduct which may be required on their part. The individual disaster-control agencies will jointly agree and coordinate the process of notifying the general public.

Responsibilities of an Operator of Nuclear Facilities

Under Section 12 of the Atomic Energy Act [1A-3] and Section 51 of the Radiation Protection Ordinance, the operator of any nuclear facility must inform its competent supervisory agency without delay of any safety-relevant deviations from specified normal operation, particularly accidents, hazardous incidents, or radiological emergency situations, and should also notify the authority responsible for public safety and the agency responsible for disaster control in the *Land* (Federal State) concerned, if necessary.

Operators are obliged to undertake their own precautionary and protective measures, known as “on-site emergency planning” for conceivable nuclear accidents, in advance. These must be detailed in the alarm code and in the emergency manual.

In accordance with Section 53 of the StrlSchV, the operator must have trained personnel and any tools which may be required on hand for controlling safety-relevant events, and must provide the authorities responsible for emergency preparedness mentioned above with the information necessary to deal with an incident. It must assist the competent authorities in planning emergency measures, and inform them of possible risks when deploying helpers, and of essential protective measures.

Specifically for the case of fire-fighting, the operator must agree necessary measures in advance in co-operation with the competent *Länder* authorities, the fire service, or the mine rescue service (in the case of repositories). In this respect, it is particularly important to clarify the special equipment required for fighting fires in the individual areas of the facility.

Raising the Alarm

The off-site emergency-preparedness service of the *Länder* may be notified of an alarm by the plant operator after a safety-relevant event has occurred, or the alarm may be raised if the readings of their own monitoring exceed the permissible limits. The criteria for the alarm being raised by the operator of the nuclear facility are specified in the operating manual of the respective facility, insofar as damage limitation measures are required under Section 53 of the Radiation Protection Ordinance. The operator may implement a preliminary categorization of the event according to the international INES scale of evaluation for nuclear facilities.

Alternatively, the Federal government may raise the alarm to the *Länder*, and parallel to this via the IMIS IT system, if the preset threshold values are exceeded on the instruments of the Integrated Measurement and Information System, which ensures comprehensive monitoring throughout the territory of the Federal Republic of Germany.

Article 25

2. *Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.*

The “Framework recommendations for disaster control in the vicinity of nuclear facilities” (*Rahmenempfehlungen für den Katastrophenschutz in der Umgebung kerntechnischer Anlagen*) [3-15] also apply to foreign nuclear facilities requiring planning measures on German territory because of their proximity to national borders. Note that such foreign nuclear facilities must facilitate the same measures for the protection of the general public as those required for German facilities; and that alarm and deployment drills must be carried out, and the details set forth in agreements with the adjacent countries.

Due to the geographical location or the radioactive inventory of nuclear facilities for the management of spent fuel assemblies or radioactive wastes on neighbouring foreign territory, disaster-control measures are not necessary in Germany in the event of accidents in these facilities. The emergency-preparedness planning is therefore carried out at the Federal level, as part of radiation prevention. The precautions in case of accidents in waste-disposal facilities on neighbouring foreign territory correspond to those applicable to other nuclear facilities, such as nuclear power plants remote from the frontiers. In order to determine the measures necessary under the Precautionary Radiation Protection Act [1A-5], a list of measures [BMU 99] is applied which includes the necessary instructions on estimating the consequences and on planning measures to be taken.

Since the early 1980s, the Federal Republic of Germany has entered into bilateral agreements with all adjoining states, and some countries further away, regarding mutual assistance in case of disasters or major accidents ([1D-1], [1D-2], [1D-3], [1D-4], [1D-5], [1D-8], [1D-9]). These agreements specify the responsibilities and points of contact, guarantee cross-border traffic of personnel and resources deployed, and stipulate mutual exclusion of liability in case of personal injury or property damage, and agree a comprehensive exchange of information and experiences. In the years following German re-unification, agreements have also been signed with Poland [1D-10], Hungary [1D-6], Lithuania [1D-7] and Russia [1D-11], and a treaty agreed with the Czech Republic [1D-12].

Germany also has an agreement with France on the exchange of information in case of events or accidents with radiological effects dating from 1981, and an administrative agreement without binding effect under international law dating from 1976.

In addition, there are agreements with neighbouring states on the exchange of information and experience in connection with safety engineering or radiation protection, all of which were concluded prior to 1985 [BMU 99a]. There is also a superordinate European regime governing radiological emergencies.

Article 26 (Decommissioning)

> *Article 26*
>
> *Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility.*

Introduction

The following account collectively outlines the provisions which apply to safety during the decommissioning and dismantling of nuclear installations. The term “decommissioning” is hereafter understood in the meaning of this Convention (Article 2 (b)) in a broad sense, i.e. decommissioning comprises all measures after final shut-down leading to the plant or the site being released from nuclear regulatory control.

Legal Basis

In Germany, the legal bases for licensing procedures for the decommissioning of nuclear facilities are the Atomic Energy Act (AtG) [1A-3], statutory ordinances promulgated on the basis of the AtG, as well as general administrative provisions. Section 7, para. 3 of the AtG contains the basic requirement for the licensing of decommissioning. It stipulates that for any installation which has been licensed according to Section 7, para. 1 of the AtG, the decommissioning, safe enclosure or dismantling of that installation or of parts thereof once operation has been permanently suspended shall require a licence. Here too, a consideration of the state of the art in science and technology is retained as a guiding principle.

The licensing procedure for the decommissioning of nuclear facilities is governed by the Ordinance Relating to the Procedure for the Licensing of Facilities in Accordance with Section 7 of the Atomic Energy Act (*Atomrechtliche Verfahrensverordnung,* AtVfV) [1A-10]. It contains regulations pertaining to decommissioning, particularly with regard to third party involvement and environmental impact assessment (EIA). The Radiation Protection Ordinance (StrlSchV) [1A-8] is also relevant for the decommissioning of other nuclear installations, as it specifies technical and operational measures, procedures and precautions to prevent damage caused by ionising radiation.

The implementation of licensed decommissioning activities is monitored by the supervising authority.

Hazard Potential of Nuclear Installations during the Decommissioning Phase

The decommissioning of a nuclear installation is characterised by a continuous decrease in the plant’s radionuclide inventory, mainly by means of removal of the fuel elements and the high-active operational waste, by decontamination and the dismantling of contaminated and activated material, as well as by the final removal of any residual radionuclides above clearance levels and the release from nuclear regulatory control. Generally speaking, this coincides with a continuous decrease in the hazard potential as dismantling progresses. Allowance is made for this fact by including specific decommissioning regulations and recommendations in the sub-statutory regulatory framework, as well as via application of the existing regulatory framework during the licensing and supervision procedure in line with the decreasing hazard potential.

Measures to Ensure Safety during Decommissioning of Nuclear Installations

The information contained in this report with respect to

- Article 18 (Implementing measures),

- Article 19 (Legislative and regulatory framework),
- Article 20 (Regulatory body),
- Article 21 (Responsibility of the licence holder),
- Article 22 (Human and financial resources),
- Article 23 (Quality assurance),
- Article 24 (Operational radiation protection) and
- Article 25 (Emergency preparedness)

also applies analogously to the decommissioning of nuclear installations. The accounts given in this report with respect to the aforementioned Articles also apply – either partially or in full – to the decommissioning of nuclear installations. Generally speaking, the same general safety standards apply during decommissioning of a nuclear facility as to its operational phase, although there are some significant differences in certain details. For example, the option of criticality no longer applies to nuclear reactors once all fuel elements have been removed from the plant, and the level of radioactivity which is discharged to the environment with authorised liquid and gaseous releases is considerably lower. Safety requirements and the implementation thereof are addressed in the remarks on Article 11.

Article 15 (Assessment of safety of facilities) of this Convention is also relevant with regard to the fact that during the decommissioning phase of a nuclear facility, it may become necessary to construct new radioactive waste management facilities. The requirements of Article 15 concerning assessment of the safety of such facilities and their environmental impact prior to construction and commission likewise apply to facilities for the treatment of radioactive waste which are constructed when decommissioning nuclear installations (cf. the remarks on Article 15). Likewise, the requirements of Article 16 (Operation of facilities) of this Convention concerning the operation of radioactive waste management facilities also apply analogously to the decommissioning phase (cf. the remarks on Article 16).

Article 26

Such steps shall ensure that:

Article 26

i) qualified staff and adequate financial resources are available;

Experience gleaned from various decommissioning projects of nuclear installations in Germany shows that the expert knowledge of the plant's operating staff is extremely valuable for the safe and efficient execution of decommissioning and dismantling. For this reason, the operating staff are involved in the decommissioning phase as far as possible.

The manner in which the availability of financial resources is secured for the decommissioning phase differs between publicly-owned installations and installations belonging to the private power utilities:

- The decommissioning of publicly-owned facilities is financed from the current budget. For most projects (Table F–3), the Federal Government covers the bulk of the costs. Financing includes all expenses incurred for the post-operational phase, disposal of the fuel elements, execution of the licensing procedure, dismantling of the radioactive part of the facility, and disposal of the radioactive wastes, including all preparatory steps.

- The financial resources for facilities belonging to the privately owned power utilities, in particular nuclear power plants, are provided in the form of reserves built up during the operational phase. It should be noted that for commercial power plants, the main emphasis is on generating profits from electricity production. The formation of reserves according to commercial law is based on the obligation under public law to ultimately remove the radioactive part of the facility, which is derived from the Atomic Energy Act. This obligation is further defined by fiscal law with regard to the valuation possibilities for taxation purposes. The existence of reserves for decommissioning guarantees that financial provisions will be available for decommissioning and dismantling after electricity production has been terminated and there are no further revenues from electricity charges. At the same time, the formation of reserves serves to assign the costs for decommissioning and dismantling, which are ultimately caused by electricity production itself, to the operational phase. - Separate reserves are formed for the disposal of the fuel assemblies.

  The power utilities manage decommissioning and dismantling (with the exception of the disposal of radioactive waste) at their own responsibility, under the supervision of the competent authorities. The allocation of reserves for the decommissioning of nuclear power plants covers all costs associated with dismantling of the plant itself. This includes the costs of the post-operational phase in which the facility is prepared for dismantling after its final shut-down (including removal of fuel assemblies and operational wastes), the costs for the licensing procedure and supervision, the costs of dismantling (dismantling and interim storage of all components and all buildings of the controlled area), and the cost of the interim and final storage of all radioactive wastes from decommissioning. The total amount of costs is estimated from cost studies which are updated regularly by the power utilities, with due regard for technical advancements and general price trends. These cost estimates are checked by the fiscal authorities.

- The above remarks also apply analogously to commercially operated fuel cycle facilities and waste handling plants.

Table F–3: Research facilities in which nuclear installations are operated or decommissioned and which are financed from public funds

Research facilities	Short description	Normal funding
Research Centre Karlsruhe (FZK)	Founded in 1956 as "Kernforschungszentrum Karlsruhe"; initial research topics: development of heavy and light water reactors. Current research in numerous fields outside nuclear technology. The "Nuclear Facilities Decommissioning" department carries out the decommissioning and dismantling of research reactors (FR-2, MZFR, KNK II) as well as the Karlsruhe Reprocessing Plant (WAK).	Federal Republic of Germany, *Land* Baden-Württemberg
Research Centre Jülich (FZJ)	Founded in 1956 as "Kernforschungsanlage Jülich"; initial research topics: development of high temperature reactors. Current research in numerous fields outside nuclear technology. Operation of research reactor FRJ-2; decommissioning of research reactor FRJ-1	Federal Republic of Germany, *Land* North Rhine-Westphalia
Research Centre Geesthacht (GKSS)	Founded in 1956 as "*Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt*" (Company for exploitation of nuclear energy in shipbuilding and navigation), operation of the nuclear ship "Otto Hahn". Current research topics in the fields of traffic and energy technology, process and biomedical technology, water and climate in coastal regions. Operation of the research reactor FRG-1, decommissioning of the research reactor FRG-2	Federal Republic of Germany, *Länder* Schleswig-Holstein, Lower Saxony, Hamburg, Bremen
National Research Centre for Environment and Health (GSF), Munich	Founded in 1964 as "*Gesellschaft für Strahlenforschung*" (Company for Radiation Research) for the construction and operation of radiation research facilities and carrying out research into the underground storage of radioactive waste. Current research topics in environmental and health research.	Federal Republic of Germany, Free State of Bavaria
Hahn Meitner Institute Berlin (HMI)	Founded in 1959; current research topics in the areas structural research, material sciences etc.; operation of the research reactor BER II	Federal Republic of Germany, *Land* Berlin
VKTA / Nuclear Engineering and Analytics Rossendorf Inc. (*Verein für Kernverfahrenstechnik und Analytik e.V.),* Rossendorf	Founded in 1957 as the "*Zentralinstitut für Kernforschung*" (Central Institute for Nuclear Research) of the former GDR; was restructured into the Research Centre Rossendorf and the *Verein für Kernverfahrenstechnik und Analytik (VKTA) e. V.* Rossendorf following reunification. VKTA carries out the decommissioning of the research reactors RFR, RRR, RAKE and of the AMOR facilities	VKTA: Free State of Saxony Research Centre Rossendorf: Federal Republic of Germany, Free State of Saxony
Various universities	Operation / decommissioning of smaller research reactors	Federal Republic of Germany, respective *Länder*

In all cases, the personnel expenditure is included in full in the calculated funds, whereby personnel costs may account for 50 % of the total costs, and in some decommissioning projects even more. In analogy to operation, the availability of the required numbers of qualified personnel for all tasks is thus guaranteed for the decommissioning phase as well. Education and training courses for achieving and maintaining the required expert knowledge, as well as research and education at universities and technical colleges, help to preserve the high standards of education and qualification in Germany. This will continue to apply in the light of the planned phase-out of nuclear power (cf. the remarks on Article 22 (i)).

Article 26

(ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;

The provisions applicable to radiation protection of a nuclear facility which is in the process of decommissioning are similar to those which apply during the operating period. Full details can be found in the remarks on Article 24 (Operational radiation protection) of this Convention.

With regard to discharges from a nuclear installation during decommissioning, the same requirements apply as during operation. Section 47, para. 1 of the Radiation Protection Ordinance (StrlSchV) prescribes limits governing the maximum doses per calendar year caused by the release of radioactive substances with air or water from these facilities or installations applicable to individual members of the general public. According to Section 47, para. 1 of the StrlSchV, provisions must be taken in order to prevent the uncontrolled discharge of radioactive substances. According to Section 47, para. 3 of the StrlSchV, the permissible discharge of radioactive substances with air and water is determined by the competent authority by limiting the activity concentrations or quantities.

The requirements pertaining to the control of emissions and immissions are regulated in Section 48 of the StrlSchV.

Article 26

(iii) the provisions of Article 25 with respect to emergency preparedness are applied;

The extent of the measures for emergency preparedness during decommissioning of a nuclear facility is adapted in line with the hazard potential posed by the facility. Essentially, however, such measures do not differ from the measures for emergency preparedness during operation. Cf. also the remarks on Article 25 of this Convention.

Article 26

(iv) records of information important to decommissioning are kept.

The keeping of records of information important to decommissioning concerns, firstly, records pertaining to the construction and operation of nuclear facilities which will need to be accessed later in the decommissioning phase; and secondly, records generated during decommissioning and which are relevant to the long-term documentation of decommissioning itself. In the following account, those two issues are dealt with separately.

Keeping of Records of Information Pertaining to Construction and Operation

Records of information and documentation pertaining to the construction and operation of nuclear power plants are regulated in KTA rule 1404 “Documentation During the Construction and Operation of Nuclear Power Plants” (cf. the list of KTA rules in the Appendix). The need for all relevant documentation to be kept available is derived from criterion 2.1 of the Safety Criteria [3-1] which stipulates that all documentation necessary for quality assessment must be kept available. This requirement is specified in KTA rule 1404:

> “The documentation arising during the construction and operation of nuclear power plants comprises all technical documents and other data carriers which will serve as proof in the licensing and supervisory procedure. As a general principle, the documents needed to assess the quality of design, manufacture, construction and testing as well as of the operation and maintenance of safety-relevant plant parts must be kept available throughout the plant’s entire lifetime.
>
> The purposes and functions of documentation are to
>
> a) indicate the existence of or compliance with statutory prerequisites (e.g. licensing prerequisites in accordance with Section 7, para. 2 of the Atomic Energy Act (AtG))
>
> b) describe the desired state of the plant and essential processes during its construction,
>
> c) permit an assessment of the actual state of the plant,
>
> d) represent the facts required for the safe operation of the plant,
>
> e) permit feedback of experience.”

These records also include the documentation of operation. In addition, KTA 1404 stipulates the following with respect to the completeness of documentation and the updating thereof:

> “The documents compiled shall be complete with respect to the safety-related information contained therein and shall describe both the desired values and the actual state of the plant and its parts.
>
> The applicant or licensee shall be responsible for the preparation, maintenance and updating of the documentation.“

This means that not only the state of the plant at the start of operation must be fully documented but that this documentation must also be adapted to all changes and must reflect the actual state of the plant at all times. This ensures that all relevant information from the operating phase is available when required for the decommissioning phase. KTA 1404 further specifies that the documentation must be safely kept at a place and in a form suitable for long-term storage, and that a secondary set of documents must be retained at a place where it is not endangered by any impact that may originate from the plant.

These requirements also apply analogously to other types of nuclear installations. Within the context of nuclear regulatory supervision, the competent authority satisfies itself that the records have been duly updated and correctly filed.

Keeping of Records of Information from the Decommissioning Phase

According to Section 70, para. 6 of the Radiation Protection Ordinance (StrlSchV), records and other documentation which are relevant to the decommissioning of a nuclear facility must be kept for 30 years from the date when the material referred to is removed from the facility or when the clearance procedure has been completed. Records and documentation must be deposited with the competent authority at the request of the latter.

Section 70, para. 6 of the StrlSchV further requires that the records and documentation must be deposited at a place designated by the competent authority without delay if activity ceases prior to the end of the prescribed period. This ensures that the relevant documentation is still kept for the required period even if the operator of a nuclear facility no longer exists.

Section G. Safety of Spent Fuel Management

Article 4 (General safety requirements)

Article 4
Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards.

The fundamental concepts of precaution regarding spent fuel management are laid down in the Atomic Energy Act (AtG) [1A-3] and the Radiation Protection Ordinance (StrlSchV) [1A-8]. According to these concepts, any unnecessary radiation exposure or contamination of persons and the environment is to be prevented, and, with due regard for the state of the art in science and technology and the particular circumstances of each individual case, is to be kept as low as practicable even where the values are below the authorized limits (Section 6 of the StrlSchV).

The planning of structural or technical measures to protect against design-basis accidents shall be based on the dose limits for the environment (Sections 49 and 50 of the StrlSchV) or shall be applied *mutatis mutandis*.

The following principles for spent fuel management are derived from the precautionary concept:

- fundamental protection targets on radioactivity confinement, removal of decay heat, subcriticality, avoidance of unnecessary radiation exposure,
- requirements regarding shielding, design and quality assurance, safe operation and safe transport removal of radioactive substances.

In order to protect against the hazards emanating from radioactive substances and control their use, the Atomic Energy Act requires that the construction and operation of nuclear installations is subject to regulatory licensing. The licensing of nuclear installations is regulated in the Atomic Energy Act (cf. the remarks on Article 19).

The formulation and performance of the licensing procedure in accordance with the Atomic Energy Act is specified in the Nuclear Licensing Procedures Ordinance, which deals specifically with the application procedure, the submission of supporting documents, the participation of the general public and the option of splitting the procedure into several licensing steps (partial licences).

Additional requirements regulate liability in case of damages [1A-11], protection against disruptive actions or other interference by third parties [3-62], [BMU 00] and the control of fissile material according to international conventions.

Article 4
In so doing, each Contracting Party shall take the appropriate steps to:

Article 4
(i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;

Measures should be taken to address the derived fundamental protection targets of reliable compliance with subcriticality and safe removal of residual heat. Particularly regarding the dry interim storage of spent fuel assemblies from LWR, HTR, prototype and research reactors, these measures should be specified in greater detail by the RSK Guideline on safety technology [4-2]. With regard to criticality safety in connection with the wet interim storage of spent fuel assemblies, KTA 3602 of the Nuclear Safety Standards Commission should be applied (see enclosed list of KTA nuclear safety standards), whilst KTA 3303 should be applied with regard to the removal of residual heat.

Within the framework of the plan approval procedure for a radioactive waste repository, here too measures must to taken to ensure that any criticality is avoided and that allowance is made for residual heat removal.

According to the safety criteria for the emplacement of radioactive wastes in a mine, the thermal output and surface temperature of the packages for the disposal of radioactive wastes should be determined in such a way that the specified properties of the packages are maintained and the integrity of the geological formation is not endangered.

Article 4

(ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;

Section 6, paragraphs 1 and 2 of the Radiation Protection Ordinance requires that any unnecessary radiation exposure or contamination of persons and the environment shall be prevented, and, taking due account of the state of the art in science and technology and the particular circumstances of each individual case, radiation exposure or contamination shall be kept as low as practicable, even where the values are below the authorized limits. Based on this, and analogous to Section 22 of the Closed Substance Cycle and Waste Management Act [1B-13], we derive the requirement to keep the generation of radioactive waste associated with spent fuel management to the minimum practicable.

In addition, according to the Guideline on the Control of Radioactive Waste with Negligible Heat Generation that is Not Delivered to a State Collecting Facility [3-59], waste originators are required to submit a waste concept containing information about the avoidance or reduction of radioactive waste generation to the competent authority of the *Länder* (Federal States).

Moreover, private operators of nuclear installations in the Federal Republic of Germany in any case have a vested interest in minimising waste volumes for economic reasons. Thus, regulatory specifications are not required.

Article 4

(iii) take into account interdependencies among the different steps in spent fuel management;

A national disposal plan is currently being developed by BMU which considers the interdependencies among the different steps in spent fuel management. The industry, the *Länder* (Federal States) and the Federal Office for Radiation Protection are all involved in the development of this plan.

Following the most recent revision of the Atomic Energy Act (AtG), according to Section 9a of the AtG it is necessary to prove to the supervising authority that adequate provisions exist for the non-hazardous reuse or controlled disposal of spent fuel assemblies (*Entsorgungsvorsorgenachweis*).

For this purpose, realistic plans are to be submitted annually showing that sufficient interim storage capacity remains available for those spent fuel elements already existing and those expected to arise in future, and that sufficient and adequate interim storage facilities are legally and technically available to meet concrete requirements for the next two years. Furthermore, similarly structured proof must also be furnished to the supervising authorities regarding the interim storage of returned wastes from the reprocessing of spent fuel elements in foreign countries, as well as for the re-use of the separated plutonium from the reprocessing of spent fuel elements in nuclear power plants, and for the whereabouts of the separated uranium from the reprocessing of spent fuel elements.

The type of conditioning and packaging of radioactive waste depends on the specifications of the acceptance criteria for radioactive waste laid down in the licence for the planned interim storage facility or repository, respectively. For example, in the case of the Konrad repository, the surrounding host rock must not be heated by more than 3 K.

Details on the respective licensing procedure can be found in the comments on Article 32 2.

Article 4

(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

The Atomic Energy Act and the Radiation Protection Ordinance require that precautions must be taken against potential damages in keeping with the state of the art in science and technology. For compliance with the state of the art in science and technology on spent fuel management, internationally accepted criteria and standards of the IAEA [IAEA 94b] [IAEA 02], the ICRP and the EURATOM Basic Safety Standards [1F-18] are also referred to. This is ensured by the nuclear licensing applicable to all nuclear installations (cf. the remarks on Article 19).

Compliance with the provisions of nuclear licensing is ensured by the supervision of the competent authorities of the Federal Government and the *Länder.*

Article 4

(v) take into account the biological, chemical and other hazards that may be associated with spent fuel management;

The precautions against damage from biological, chemical and other hazards make allowance for the provisions of other legal fields (cf. the remarks on Article 19). This primarily concerns the reprocessing and disposal of spent fuel assemblies. There are no reprocessing plant in operation in Germany. Regarding disposal, allowance is made for biological, chemical and other hazards within the frame of the safety analyses. No impacts are derived from interim storage, because the casks, as part of the interim storage system, ensure leak-proof confinement.

In addition, the Nuclear Licensing Procedures Ordinance regulates environmental impact assessment and compliance with other licensing requirements (e.g. for non-radioactive emissions and discharges into waters).

Article 4

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

There are no plans for the long-term interim storage of spent fuel elements in Germany. Interim storage is limited to a maximum of 40 years. The valid safety criteria [4-2] require that the permitted impacts of interim storage remain at a consistently low level throughout the entire period.

Safety criteria for the emplacement of radioactive wastes in a mine entered into force in Germany in 1983 [3-13]. They are being further developed with due regard for national and international developments, and consider the recommendations of the ICRP and OECD/NEA, the standards of the European Communities, and the safety principles of the IAEA on radioactive waste management [IAEA 95]. In particular, they fully consider Principle 4 of the IAEA not to expose future generations to radiological impacts in excess of those accepted today.

Accordingly, the impacts of a release of radionuclides from repository operation in Germany must not exceed the dose limits applicable to nuclear power plants today. For the post-operational phase, the safety criteria [3-13] implicitly specify a dose limit of 0.3 mSv per calendar year.

Development of a concept for the direct disposal of spent fuel assemblies has reached technical maturity. Prototypes of casks for disposal now exist.

Article 4

(vii) aim to avoid imposing undue burdens on future generations.

The controlled phasing-out of the use of nuclear energy for the commercial generation of electricity is regulated by the amended Atomic Energy Act which entered into force on 27 April 2002. This also limits the generation of further nuclear waste and minimises the risk of resultant possible burdens on future generations.

The safety criteria for disposal [3-13] in Germany already make allowance for Principle 5 of the IAEA [IAEA 95]. They ensure that no undue burdens are imposed on future generations. In this respect, financial resources have been set aside by the operators of the nuclear power plants for the direct disposal of spent fuel assemblies on the basis of the Ordinance on Advance Payments (EndlagerVlV) [1A-13].

Around 45 % of these reserves are intended for decommissioning and removal, whilst the remaining 55 % are intended for disposal. If required, the reserves will also cover the interim storage of spent fuel elements and radioactive waste in Germany until transportation to the repository.

Once a repository has been sealed, permanent monitoring is not necessary. For this reason, no further costs are incurred after sealing that would have to be borne by future generations.

Article 5 (Existing facilities)

Article 5

Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

The fundamental requirements governing the preventive action to be taken are set forth in the Atomic Energy Act (AtG) [1A-3], the Radiation Protection Ordinance (StrlSchV) [1A-8] and other legal provisions, as well as in substatutory regulations (cf. the remarks on Articles 18 to 20) which satisfy, and in some cases exceed, all the requirements of this Convention. An explicit review to verify compliance with the requirements of this Convention is therefore not felt to be necessary.

Furthermore, existing facilities are also subject to continuous regulatory control throughout their entire operational life. If there are any advancements in the state of the art in science and technology, the regulatory body may insist on a corresponding upgrade in safety in accordance with the provisions of Section 17 of the AtG.

Independently from this, the regulatory framework governing the safe management of spent fuel [4-2] envisages regular reviews intended to ensure the continued compliance with the protection targets stipulated in the Act in line with the latest state of the art in science and technology. The protection targets encompass the protection of the general public in the vicinity of the facility, the protection of the environment and the protection of operating personnel, as well as the protection of property against the effects of ionising radiation.

Article 6 (Siting of proposed facilities)

Article 6

1. *Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:*

Article 6 1.

(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;

Section 7, para. 1 of the Atomic Energy Act (AtG) [1A-3] regulates the licensing of stationary installations for the management of spent fuel elements, whilst the licensing of the mere storage of nuclear fuel outside Government custody is regulated in Section 6, para. 1 of the AtG. In order to obtain such a licence, the applicant must submit documentation containing all the relevant data required for the purposes of assessment. This data is summarised in the safety report (*Sicherheitsbericht*), a key document in the licensing procedure. The nature and scope of documentation and the data it contains are regulated in the Nuclear Licensing Procedures Ordinance (AtVfV) [1A-10].

Section 2 of the AtVfV prescribes that the licence application for the planned construction of a new facility must be submitted in writing to the licensing authority. This application must also contain data pertaining to all relevant site-related factors.

Section 3 of the AtVfV specifies the nature and scope of documentation referred to in greater detail in the remarks on Article 19 2. (ii). Usually, the required information pertaining to the site and the installation is compiled in the safety report and supporting documents. The relevant sections of a safety report generally refer to the following site-specific data: geographic location, human settlements, land use within a 10 km radius, traffic, meteorological conditions, geological conditions, hydrological conditions, seismic conditions, radiological exposure at the site due to pre-radiation, auxiliary and emergency installations in the vicinity of the site.

An Environmental Impact Assessment (EIA) is required for installations which are listed in Appendix 1 of the Environmental Impact Assessment Act (UVPG) [1B-14]. According to nos. 11.1 and 11.3 of Appendix 1 of the UVPG, an environmental impact assessment is required for the construction and operation of facilities for the treatment of spent fuel elements, as follows:

11.1 Construction and operation of a stationary installation for the production, treatment, processing or fission of nuclear fuel or the reprocessing of irradiated nuclear fuel

11.3 Construction and operation of a facility or installation for the treatment or processing of irradiated nuclear fuel or highly radioactive waste or for the sole purpose of storage of irradiated fuel or radioactive waste which is scheduled to last for more than 10 years at a place different from the one where these materials have arisen.

The licence application must be accompanied by further documents as specified in Section 3, para. 2 of the Nuclear Licensing Procedures Ordinance (AtVfV) (cf. the section on EIA under the remarks on Article 19 2. (ii)).

Within the meaning of Article 6 1. (i) of the Convention, this detailed information will enable the authorities and any authorized experts consulted by them to assess all relevant site-related factors which might affect the safety of spent fuel management facilities during their operational life.

Article 6 1.

(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;

In addition to the information outlined in the remarks on Article 6 1. (i), the safety report and the auxiliary documents must contain data on the following topics (cf. also the remarks on Article 19 2. (ii)):

- Description of construction and operation, including an overview of the entire project; plant operating procedures, quality management concept, fire protection concept, documentation etc.
- Operational radiation protection: radiation protection areas in the plant, radiation and activity monitoring in rooms and in the plant, physical radiation protection monitoring of individuals, monitoring of releases of radioactive substances and environmental monitoring, surveillance of material which is released from the controlled area, measures to reduce exposure of personnel and in the environment
- Incident (design basis accident) analysis: Description of the protection targets, possible incidents, incident analysis for operation, exposure as a result of incidents
- Waste and residual material management: Release of cleared material from the operation, conditioning, storage and (if relevant) transfer of radioactive operational waste
- Exposure in the environment: Applicable limit values for discharges with air and water including substantiation, calculation of the exposure resulting from the discharge of radioactivity and from direct radiation, exposure as a consequence of incidents

- Further effects of plant operation on the environment: Description, analysis and evaluation of the effects on man, animals, plants, soil, water, air, climate and landscape as well as cultural and other material assets.

In addition to this, other information relating to the site and the planned facility as outlined above are also relevant in this context. Within the meaning of Article 6 1. (ii) of this Convention, this will enable the competent authorities and any authorized experts consulted by them to assess the presumed effects of a spent fuel management facility on the safety of individuals, society and the environment.

Article 6 1.

(iii) to make information on the safety of such a facility available to members of the public;

Projects to construct a spent fuel management facility are publicly announced in accordance with the provisions of Section 4 of the Nuclear Licensing Procedures Ordinance (AtVfV). The public hearing which may be necessary is regulated in Sections 8 to 13 of the AtVfV. The related procedures are described in the section on involvement of the public under the remarks on Article 19 2. (ii).

This approach, particularly the involvement of the public as defined in the AtVfV and the Environmental Impact Assessment Act (UVPG), ensures that the general public has access to all the necessary information regarding the safety of planned spent fuel management facilities as stipulated by Article 6 1. (iii) of this Convention.

Article 6 1.

(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

Section 7a of the AtVfV regulates the procedure for cases of transboundary environmental impacts; this procedure is also relevant to spent fuel management facilities. According to Section 7a, para. 1 of the AtVfV, the competent authorities of the foreign state are notified of the project with respect to EIA at the same time and to the same extent as the authorities which are to be involved under the terms of the German Atomic Energy Act, in cases where

- a project which is subject to EIA may have substantial impacts (as described in the safety report or in the information on other environmental impacts) on the protected entities cited in Section 1a of the AtVfV (man, animals, plants, soil, water, climate, landscape, cultural or other material assets) in a foreign state, or
- a foreign state which may be substantially affected by such impacts requests this information.

An appropriate period is set for the competent authorities of the foreign state to indicate whether they would like to be involved in the process.

The licensing authority in Germany should ensure that the project is publicly announced in a suitable way in the foreign state, that details are given of the authority to whom any objections may be submitted, and that mention is made of the fact that any objections not founded on titles under private law are excluded once the set period for objections has expired.

On the basis of Sections 2 and 3 of the AtVfV, the German licensing authority will give the involved authorities of the foreign state the opportunity to voice their opinions on the application on the basis of the submitted documents within an appropriate period before reaching its decision. Citizens of that state are accorded equal status with German citizens with respect to their further involvement in the licensing procedure.

Section 7a, para. 2 of the AtVfV specifies that upon request, the applicant must supply translations of the required summary, as well as any other information about the project which may concern transboundary involvement, in particular concerning transboundary environmental impacts.

According to Section 7a, para. 3 of the AtVfV, consultations are to be held, where necessary, between the supreme German Federal and the authorities of the *Länder* (Federal States) and the competent authorities of the foreign state regarding the transboundary environmental impacts of the project and any measures for avoiding or ameliorating them.

Furthermore, Section 8 of the Environmental Impact Assessment Act (UVPG) shall also apply to the participation of the authorities in other countries, insofar a protected commodity in another state may be affected.

In addition, Article 37 of EURATOM [1F-1] requires each member state of the European Atomic Energy Community to provide the European Commission with general data relating to any plan for the disposal of radioactive waste in whatever form which will enable it to determine whether the implementation of such a plan is liable to result in the radioactive contamination of the water, soil or airspace of another Member State. This also satisfies the requirements of Article 6 2. of this Convention. Such data usually comprise details of the site, the plant, the release of radioactivity into the atmosphere or in liquid form during normal operation, the management of solid radioactive waste, any unplanned releases of radioactive substances, and environmental monitoring.

Article 6

2. *In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.*

The effects of the operation of spent fuel management facilities on protected commodities, such as man, animals, plants, soil, water, air, etc., are described in the documents supplied by the applicant, as outlined in the remarks on Article 6 1.

Effects on other Contracting Parties of this Convention which are adjacent to the spent fuel management facility may result from the licensed liquid and gaseous releases from the plant during normal operation and from possible additional releases to the environment during incidents:

- The release of radioactivity during normal operation is limited by Section 47 of the Radiation Protection Ordinance (StrlSchV) [1A-8] in such a way that the doses resulting from discharges with water and air will not exceed the dose limits specified in Table F–1 for any individual member of the general public per calendar year.
- The release of radioactivity during incidents in spent fuel management facilities is regulated by the provisions of Sections 49 and 50 of the StrlSchV, respectively, depending on the type of facility. Section 49 of the StrlSchV specifies that for local interim storage facilities for spent fuel elements, the doses caused by releases of radioactive substances into the environment in the case of the most severe design basis accident must not exceed the limits specified in Table F–1. In cases falling under the scope of Section 50 of the StrlSchV, the nature and extent of protective measures are stipulated by the competent authority, with due consideration for the

individual case, particularly with regard to the hazard potential of the plant and the likelihood of an incident occurring.

Concerning the effects on other Contracting Parties, it is important to consider that the AtVfV prescribes the involvement of the authorities of affected neighbouring states (see above). As such, those authorities will be informed about the possible radiological effects of normal operation of the plant as well as any potential incidents. Provided the specified dose limits, which correspond to the relevant EU regulations and to international standards, are also used as a basis by other Contracting Parties, then the effects will also be acceptable to them.

Article 7 (Design and construction of facilities)

Article 7
Each Contracting Party shall take the appropriate steps to ensure that:

Article 7
(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

Section 7, para. 1 of the Atomic Energy Act (AtG) in the version promulgated on 22 April 2002 [1A-3] stipulates that no further licences will be issued for the construction and operation of facilities for the reprocessing of irradiated nuclear fuel. As there are no longer any reprocessing plants in Germany, this type of facility is not pertinent to the present report.

A pilot spent fuel conditioning plant was constructed at Gorleben, and was designed for the packing of spent fuel elements into casks ready for disposal. Licensing of this plant was completed with the granting of a third partial construction licence, but under the terms of the licence issued on 19 December 2000, operation of the plant was restricted to the repair of defective containers.

Interim storage of spent fuel elements takes place in the central storage facilities at Ahaus, Gorleben and ZLN, as well as in temporary storage facilities at various nuclear power plant sites. Storage at on-site interim storage facilities as defined in Section 6 of the AtG is also either at the planning stage, or licensing procedures to this effect are currently under preparation. The radiation protection objectives as defined in Section 1 of the AtG or in Section 1 of the Radiation Protection Ordinance (StrlSchV) [1A-8] apply to these installations.

These protection objectives were duly considered when licensing the central interim storage facilities and when granting the partial licences for the pilot spent fuel conditioning plant at Gorleben.

Within the course of the licensing procedures currently ongoing for the on-site interim storage facilities, the competent authority (the Federal Office for Radiation Protection) has taken care to ensure that the relevant regulations are observed. This means that even at the design phase, constant checks are implemented to verify compliance with the objectives of radiation protection. This applies to normal operation as well as to uncontrolled releases in case of incidents.

Article 7

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

The decommissioning of a spent fuel management facility is governed by the same legal prerequisites and peripheral requirements as other nuclear installations. The operation of spent fuel management facilities is licensed for a specified purpose and the facilities must be removed once the licence has expired. There are also regulations governing decommissioning and dismantling. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has decreed that the RSK safety guidelines on dry interim storage of irradiated fuel elements in containers [4-2] must be observed. A further order from the BMU stipulates that this shall be applied analogously to temporary storage facilities. This guideline contains the following provision concerning decommissioning (section 2.16):

“The interim storage facility for spent fuel elements shall be designed and built in such a way that it can be decommissioned in compliance with the radiation protection regulations and can either be made available for alternative use or removed. Prior to any further use or the dismantling of the storage building, it must be demonstrated by measurements that the building is not contaminated or has been sufficiently decontaminated and is free of any inadmissible activation. The requirements under building and waste law shall be observed.” This means that the radiation protection principles and requirements set forth in the StrlSchV must be observed during the decommissioning and dismantling of these types of facilities. However, additional regulations from the Closed Substance Cycle and Waste Management Act and the building regulations of the *Länder* (Federal States) must also be observed. Those statutory requirements combine to form the legal framework within which the technical execution of decommissioning is to be planned, which must furthermore be in line with generally accepted technical rules.

Article 7

(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

The construction of installations in Germany is governed by the commonly accepted technical rules – e.g. as laid down in the DIN/EAN standards. In the nuclear sector, the requirements specified in KTA rules additionally apply (cf. the remarks on Article 13 2. (i)) and the state of the art in science and technology must also be observed.

These standards, as well as the state of the art in science and technology, are derived from experience. Hence, in Germany, the experience gleaned from nuclear research installations as well as from industrial application have been incorporated into the regulatory framework. Technical rules are issued by the KTA, which is comprised of representatives from research, industry and administrative bodies who pool their experience from the various different areas of nuclear safety.

The development of transport and storage containers is based on many years of experience in the design and manufacturing of such containers, as well as on testing e.g. by drop tests and by numerical analysis based on experimental results. Both publicly and privately funded research programmes (e.g. long-term safety analyses) address specific issues, the results of which are incorporated into the revisions of existing KTA rules as well as in the specification of new rules.

Article 8 (Assessment of safety of facilities)

The assessment of the safety of nuclear facilities for the treatment of spent fuel assemblies (central and local interim storage facilities and temporary storage facilities, and the Gorleben pilot conditioning plant PKA), and the assessment of environmental impacts conducted prior to the construction of such a facility, take place within the context of a licensing procedure (cf. remarks on Article 19 2. (ii)).

An assessment of the safety and environmental impacts conducted prior to commissioning takes place within the context of the accompanying supervision under the relevant nuclear laws.

Article 8

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

Article 8

(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

The construction and operation of nuclear facilities for spent fuel management is subject to licensing under the Atomic Energy Act (AtG) [1A-3]. For the building work, a building permit is also required under the Building Code of the respective *Land* (Federal State), unless the nuclear facility has a direct operational link to a nuclear facility for the production, treatment, processing, or fission of nuclear fuels, or itself constitutes such a facility.

Applications for licences under the Atomic Energy Act must be submitted to the competent licensing authority. The application must include a statement on the extent to which the nuclear facility ensures the necessary precautions against damage resulting from the treatment of spent fuel assemblies according to the state of the art in science and technology, and meets the requirements of the rules and regulations in force. The nature and content of the documents submitted with the application must meet the requirements of the Nuclear Licensing Procedures Ordinance (AtVfV) [1A-10], or in the case of facilities for the storage of spent fuel assemblies, must fulfil them *mutatis mutandis*. The documents required (see also KTA 1404, cf. the list of KTA rules in the Appendix) are listed in detail in the remarks on Article 19 2. (ii) and (iii).

Under Section 12b of the Atomic Energy Act (AtG), the competent authorities carry out checks on the reliability of the persons responsible for the handling of radioactive substances, so as to guard against unauthorized actions which could lead to misappropriation or the substantial release of radioactive substances [1A-19].

In order to implement the corresponding European requirements for an environmental impact assessment under [1F-13], which have been implemented in national law by the revision of the Environmental Impact Assessment Act (UVPG) [1B-14], an environmental impact assessment is conducted as a subsidiary part of the licensing procedure for the construction of nuclear facilities for the storage of spent fuel assemblies for which applications have been submitted since 1999. In such cases, the following documents must be added to the application:

- a presentation of the possible effects of the project on humans, fauna, flora and their habitats, on water, air, and the climate, as well as on the landscape and cultural and material assets,
- an overview of the technical process alternatives examined by the applicant, and the reasons for selection, if significant, as well as

- notes on any difficulties experienced in compiling the information for the assessment of environmental impacts.

According to Section 20 of the AtG, the competent authorities may call upon independent experts in the licensing and supervision procedure. The basic requirements governing expert opinions are formulated in a directive [3-34]. The independent experts review in detail the documents and licensing prerequisites submitted by the applicant. On the basis of the evaluation standards, details of which must be included in the expert opinion, they perform their own tests and calculations – preferably using methods and programs other than those of the applicant – and give an expert assessment of these results. Unless there are specific provisions governing the safety assessment of nuclear facilities for the treatment of spent fuel assemblies, any relevant rules from the existing set of rules and regulations for the safety assessment of nuclear power plants are applied *mutatis mutandis* (e. g. [3-23], [3-33], [3-1] and KTA 2101). Specific requirements for nuclear facilities for the treatment of spent fuel assemblies may be derived from international recommendations, such as those of the IAEA ([IAEA 94] and [IAEA 94a]).

Because large numbers of applications for licences were received for facilities for the dry interim storage of irradiated fuel assemblies in containers, guidelines were recommended in 2001 [4-2] by the Reactor Safety Commission (*RSK*). According to these guidelines, the technical design and operation of the interim storage facility must meet the following radiological protection targets in order to ensure that the precautions against damage reflect the state of the art in science and technology:

- Secure containment of the radioactive inventory
  The barriers or fuel-assembly casks that ensure the containment must retain sufficient integrity (monitoring of sealing function, formulation of a repair concept) under all credible circumstances (hazardous incidents, accidents, ageing, impacts, etc.)

- Avoidance of unnecessary radiation exposure, limitation and monitoring of the radiation exposure of operating personnel and the general population
  Adherence to the corresponding limit values of the Radiation Protection Ordinance (StrlSchV) [1A-8], even in the most unfavourable case (receiving and dispatching checks on the fuel-assembly casks, formulation of a radiation-protection concept, division of the interim storage facility into radiation protection zones, radiation monitoring in the interim storage facility and the vicinity).

- Reliable maintenance of subcriticality
  Proof of the criticality safety of the fuel assemblies during storage shall be demonstrated for the least favourable conditions to be expected during specified normal operation (limitation of the enrichment of the fuel assemblies, exclusion or limitation of neutron moderation, use of neutron absorbers, maintenance of the appropriate spacing) [DIN 25403], [DIN 25474].

- Sufficient removal of heat from radioactive decay
  Even in the case of combined impacts on the effectiveness of heat removal, the operators must guarantee that only admissible temperatures will occur. The mechanisms of heat removal must be independently operative as far as possible (passively by natural convection).

From these protection goals, further requirements can be derived which are essential for compliance with the above targets:

- Shielding of the ionizing radiation,

- Design, execution, and quality assurance suitable for operation and maintenance (KTA 1401, cf. list of KTA rules in the Annex),

- Safety-oriented organization and performance of operation,
- Safe shipment off-site of the radioactive materials (see also [IAEA 96a]),
- Design against accidents, and provision of measures to reduce the harmful effects of events that exceed the design parameters (incident analysis). Calculation of the effects of hazardous incidents and of pre-existing pollution prevailing at the site before the facility is erected is regulated by [2-1] and [3-33].

In addition, external impacts of natural and artificial origin are also to be considered, according to the guidelines (cf. also [BMU 00], [3-62]). These impacts will be assessed in the licensing process by the competent licensing authority. Recommendations for disaster management procedures are given in [3-15] (cf. the remarks on Article 25).

Aspects of operational service life are taken into account by agreeing that the service life of on-site interim storage facilities and of the storage life of a container should be limited to forty years, and taking this period into account in licensing procedures. If there is no time limit on the operating licence of facilities, the competent authority may impose retrospective conditions stipulating that facilities are modified in line with the state of the art in science and technology during the course of their service life.

Article 8

(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

The review of the safety of nuclear facilities that accompanies their construction prior to commissioning is carried out by the competent supervisory authority under the Atomic Energy Act. The latter determines whether the statements contained in the documents submitted, and any supplementary requirements in the licence, are being observed and implemented. Independent experts are also consulted for these supervisory duties.

Under the Atomic Energy Act, the supervisory authority for spent fuel management facilities is the competent supreme agency of the respective *Land* (Federal State).

According to the Reactor Safety Commission's guidelines [4-2], with regard to the operation of an interim storage facility, precautionary measures against damage must be taken in particular for all procedures leading to first-time achievement of the normal operating state of the nuclear facility (commissioning).

The precautionary measures specified therein include:

- commissioning tests of all equipment of the storage facility (commissioning program),
- preparation of instructions for operational procedures and procedures for the management of incidents and eliminating the consequences thereof (operating manual in accordance with KTA 1201; cf. list of KTA rules in the Annex),
- drafting of implementing provisions for adherence to the Technical Acceptance Conditions (*Technische Annahmebedingungen*) (the boundary conditions for vessel properties and fuel assemblies used in the safety studies),
- the keeping of an inspection manual on in-service inspections (inspection manual according to KTA 1202; cf. list of KTA rules in the Annex),

- centralized registration and documentation of fault signals,
- exchange of experience among the various operators of interim storage facilities,
- the regulation of maintenance work with regard to its performance and access to the facilities,
- adequate staffing levels of qualified personnel,
- drafting a plan for emergency plant protection measures,
- submission of a monitoring concept for controlling the long-term and ageing effects during the service life applied for.

Article 9 (Operation of facilities)

In Germany, only interim storage facilities are operated for spent fuel management. The pilot conditioning plant (PKA) has not yet commenced operation.

An interim storage facility is operated in such a way that the required precautions against damage are taken in line with the state of the art in science and technology. This is ensured by nuclear licensing and supervision by the authorities. In particular, consideration is given to the following operating states:

- specified normal operation,
- the identification and control of abnormal operation and incidents, as well as the elimination of their consequences.

Article 9

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

Article 9

(i) the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

Before a facility can commence operation, it is subjected to commissioning tests. These tests are specified in a commissioning programme which ensures that the safety requirements specified in Article 8 are fulfilled. The commissioning programme is subject to the approval of the competent authority. The tests serve to demonstrate that the installations have been constructed in a suitable manner to comply with the planned operation and can be operated as specified. The results are documented.

The entire operation should be structured in a suitable manner so as to ensure the safe performance of the operational processes. In particular, the administrative prerequisites regarding personnel, organisation and safety must be fulfilled. The authority supervises compliance with these prerequisites. Clear instructions must be formulated in an instruction manual for operational processes, accident management and elimination of the consequences of incidents and accidents. Competencies and responsibilities must be clearly defined. The competent authority supervises compliance.

At each facility, cold testing with one cask for each cask type licensed for storage is performed for the entire handling procedure, including radiation protection measures, before casks are stored there for the first time.

Article 9

(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;

All operational processes and the measures to be taken in case of incidents are described in form of clear service instructions, which are laid down in an instruction manual. In particular, all aspects relating to safety must be addressed, and the procedure in the event of modifications or additions of system components and procedures must be specified. This is intended to ensure that the personnel is able to promptly and confidently initiate and perform the necessary measures in case of abnormal operation or incidents. This procedure is subject to regulatory supervision.

For interim storage facilities, the assumptions and boundary conditions for cask properties and fuel assemblies used in the safety inspections are compiled in the form of technical acceptance criteria. Performance criteria are drawn up for compliance with the technical acceptance criteria. This also includes operating instructions and test procedures which must be taken into account during the loading of the casks. Compliance is supervised by experts from the competent supervisory authority.

Article 9

(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;

Regulatory supervision ensures compliance with the procedures on operation, maintenance, monitoring, inspection and testing established in the nuclear licensing procedure for spent fuel management facilities.

In particular, the design of a storage facility ensures that the decay heat from the fuel assemblies is removed and that the temperatures occurring in connection with casks, their inventory and in the storage building are within the permissible limits. Heat is released safely to the environment via natural convection. This means that no active ventilation components/systems are required.

Cask temperatures endangering the gamma and neutron radiation shielding or the leak-tightness of the cask do not occur. The fuel rod temperatures remain low enough to preclude a systematic failure of the fuel-rod cladding. In storage buildings, temperatures in the structural assemblies do not exceed the design temperatures.

The design of the storage facility ensures the maintenance of subcriticality even in the event of abnormal operation and incidents, e.g. if the casks are arranged in close packs and especially if they are flooded with water, if they have been wrongly loaded or if changes occur in the structure of the fuel assemblies and the fuel basket, which can happen during long-term storage.

A monitoring system is used for operational monitoring of the sealing function of the casks. This sends a signal to a central monitoring point as soon as a malfunction occurs in one of the two cask sealing systems. The monitoring system allows the affected cask to be identified.

On reception, fuel element casks are checked for compliance with the limits applicable to the interim storage facility by means of gamma and neutron dose rate measurements. In addition, incoming casks are examined for surface contamination. Only casks whose surface contamination does not exceed the admissible limits according to Annex III, Table 1 of the Radiation Protection Ordinance (StrlSchV) [1A-8] are emplaced in the storage facility. Furthermore, only casks which were loaded in accordance with the technical acceptance criteria of the respective interim storage facility are accepted. If emplacement is taking place from a neighbouring nuclear power plant without shipment along public transport routes, provisions may be made whereby certain parts of the mandatory controls during loading in the nuclear power plant may be dispensed with on emplacement in the interim storage facility.

The radiation protection concept of the storage facilities covers all operating sequences during specified normal operation, measures for preventive maintenance, monitoring, measuring, in-service inspection, repair and for the collection and disposal of operational radioactive waste, and also includes the precautions and measures against accidents and emergencies. The responsibilities, competencies and organisation of radiation protection are clearly and unambiguously defined. The registration and evaluation of operational processes and special events that are relevant to radiation protection is ensured.

Within the storage areas, the local dose and the local dose rate are measured and documented following every change in the emplacement plan, but at least once a year. These measurements are performed at representative points, covering the gamma and neutron doses. Mobile measuring equipment must be provided to a sufficient extent and used, in particular, during the performance of maintenance measures.

The atmosphere in working areas where contaminations may occur is monitored for control purposes, e.g. by means of mobile air sample collectors. Transport areas within the storage area, persons, work places, transport routes and mobile objects are all checked for contamination by suitable means and the results documented. Suitable decontamination facilities must be provided and organisational specifications made.

In order to ensure the radiological work safety of the operating personnel, air samples are taken at regular intervals in the storage area near the emplaced casks and subsequently analysed.

The correct functioning of the equipment provided and used for radiation monitoring is systematically and regularly checked.

For interim storage facilities, the local dose (gamma and neutron dose) is monitored at representative points, e.g. at the fence of the facility.

The facility must have sufficient numbers of qualified personnel to ensure the fulfilment of safety requirements, who must be trained on a regular basis. The same shall also apply when personnel from neighbouring nuclear installations are deployed. The technical qualification required depending on the staff member’s position is verified in accordance with the requirements of the Radiation Protection Ordinance (StrlSchV) or other special regulations. The requirement concerning responsibility for nuclear safety issues is regulated by the Atomic Energy Act (AtG) [1A-3] and the StrlSchV.

A monitoring concept is drawn up in order to control long-term and ageing effects during the interim storage facility’s operational period as detailed in the licence application. Here, a general distinction is made between parts and components that are designed for the entire period of use of the facility, and those that may need to be replaced.

Parts and components designed for the entire operational period include the storage casks for the fuel assemblies, including the components for the system to monitor the leak-tightness of these casks, as well as the storage building itself. In particular, safety-relevant cask components, such as the sealing barrier and the neutron moderator, indicate the required longevity. Here, distinction is made between the operational period of the storage facility and that of the cask.

The essential safety-related properties of the systems, parts and components are ensured for the entire operating period. In particular, the condition of the lifting trunnions must allow the casks to be moved within the facility at any time.

Article 9

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;

We have already reported on the measures to ensure engineering and technical support during the operating lifetime of the facilities by providing adequate competent staff in the remarks on Article 22 (i).

The technical systems and equipment used for outward shipment of the fuel element casks are kept available until all casks loaded with fuel assemblies have been removed.

All auxiliary systems, such as crane and monitoring systems, are provided and maintained throughout the operating lifetime of the facility.

Periodic testing is performed on all essential systems and equipment. The respective tests are specified in a testing manual. The technical equipment required for this purpose is kept available throughout the facility's operating lifetime.

Article 9

(v) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

The obligation incumbent open operators of facilities licensed according to Section 6 or Section 7 of the Atomic Energy Act (AtG) [1A-3] to report accidents, incidents and other events significant to safety to the supervisory authority is regulated in the Nuclear Safety Officer and Reporting Ordinance (AtSMV) [1A-17].

Operation of the facility is monitored to check that safety-relevant disruptions to operation and incidents are reliably detected and the corrective measures specified in the instruction manual can be taken. Fault signals are recorded and documented centrally and, depending on the severity of the incident, reported to the authority in a timely manner.

Safety-relevant findings from initial start-up, specified normal operation (especially in case of repairs) and in-service inspections are documented and submitted to the supervisory authority. Any consequences derived from the evaluation of the incidents are taken into account in the operating procedures.

Article 9

(vi) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

In view of the obligation of the authorities to take precautionary action, incidents significant to safety must be reported in accordance with the Nuclear Safety Officer and Reporting Ordinance

(AtSMV). Such incidents are recorded and evaluated at the incident registration centre of the Federal Office for Radiation Protection.

In addition, with regard to components and parts that might require replacement, care is taken to ensure that this work is performed without major impairment to the operating processes at the interim storage facility and preferably shielded off from the radiation field of the storage casks, and that sufficient accessibility is provided.

The monitoring concept ensures the monitoring of the overall status of the facility and as a minimum requirement ensures the following:

- Reports on the condition of the storage building and the components required for interim storage are regularly prepared by the operator at intervals of ten years.
- The condition of the storage building and the components required for interim storage are controlled by means of walk-downs and suitable measurements.
- Recurrent subsidence measurements are performed for the storage building.
- Random inspections are performed on the storage casks.
- The findings from in-service inspections are evaluated.

Experiences from the operation of similar plants are incorporated into plant management. For this purpose, procedures are put in place to ensure an exchange of experiences (e.g. on the basis of operating reports) between plant operators.

Article 9

(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

Spent fuel management facilities are designed and constructed in such a way that they can be decommissioned in compliance with the regulations on radiological protection and then either be reused or disposed of. Proof to this effect is checked during the course of the nuclear licensing procedure. Applications for changes to the licensed condition of the facility must either be submitted to the supervising authority for approval or in case of significant modifications to the licensing authority. Before further use or demolition of the storage building, proof that the building is either not contaminated or has been decontaminated sufficiently and is free of inadmissible activation must be furnished in the form of measurements. The requirements under construction and waste law must also be observed. The supervisory authorities of the *Länder* (Federal States) ensure that a corresponding exchange of expertise takes place at the level of supervision and with the experts also consulted.

Article 10 (Disposal of spent fuel)

Article 10

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.

In Germany, all spent fuel elements from nuclear power plants are to be disposed of directly, with the exception of those delivered to a reprocessing plant up until 30 June 2005. After 30 June 2005, the transportation of fuel elements from nuclear power plants for reprocessing will be prohibited.

Under the direct disposal concept, spent fuel elements are to be packed in containers suitable for disposal after having been held in storage for several decades (a period of 40 years has been applied for and approved), and these containers are then to be sealed and emplaced in galleries or bore holes in deep geological formations.

Since no repository has yet been implemented which is capable of accommodating spent fuel elements, there are only conceptual considerations available on the design of such a repository (cf. the comments on Articles 13, 16 (ix) and 17).

Section H. Safety of Radioactive Waste Management

Article 11 (General safety requirements)

> *Article 11*
>
> *Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.*
>
> *In so doing, each Contracting Party shall take the appropriate steps to:*
>
> *(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;*
>
> *(ii) ensure that the generation of radioactive waste is kept to the minimum practicable;*
>
> *(iii) take into account interdependencies among the different steps in radioactive waste management;*
>
> *(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;*
>
> *(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;*
>
> *(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;*
>
> *(vii) aim to avoid imposing undue burdens on future generations.*

The remarks on Article 4 apply analogously to Articles 11 (i) to (vii).

Article 12 (Existing facilities and past practices)

> *Article 12*
>
> *Each Contracting Party shall in due course take the appropriate steps to review:*

> *Article 12*
>
> *(i) the safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;*

The general requirements regarding the precautionary measures to be taken are stipulated in the Atomic Energy Act (AtG) [1A-3], in the Radiation Protection Ordinance (StrlSchV) [1A-8] and in other legal regulations. The safety requirements of the IAEA, as included e.g. in [IAEA 00a], are also observed.

The protection targets extend to the protection of the local population in the vicinity of the facility, protection of the environment, protection of the operating personnel, and the protection of property against the effects of ionising radiation (cf. the remarks on Article 11). Compliance with these protection targets also satisfies the requirements of the Convention. This is ensured by nuclear licensing and supervision.

In the following account, a distinction is made between facilities for the storage and vitrification of HAWC solution, and facilities for the treatment and storage of wastes with negligible waste generation.

Safety of Storage of HAWC Solution and the Vitrification Method

The HAWC solutions generated during the operation of the Karlsruhe Reprocessing Plant (WAK) are currently being stored and are intended for vitrification. The Karlsruhe Vitrification Plant (VEK) is being built for this purpose.

The safe storage of the HAW solutions is ensured by

- the safe enclosure of the activity by two barriers,
- the removal of the decay heat, and
- the removal of the radiolysis gases via the exhaust system.

The storage tanks are also protected against external impacts.

Once vitrification is complete, the storage tanks are decontaminated and dismantled. This constitutes part of the decommissioning procedure of the reprocessing plant.

In terms of equipment technology, process control and handling techniques, the safety of the methods used for vitrification at the VEK plant, which is currently under construction, is based on the comprehensive experience gleaned from the PAMELA vitrification plant in Mol and at the WAK, as well as from cold-test research facilities, and complies with the state of the art in science and technology.

Within the context of the licensing procedure, the extent of testing of the safety-relevant components and systems as well as the participation of independent experts is defined.

During construction, the supervisory authority performs checks within the framework of quality assurance to verify whether the specified requirements for systems and components have been met. The results are recorded in inspection reports. Independent experts may be involved in this task.

During operation, key safety-relevant systems and components are rechecked at regular intervals. During these checks, the inspectors verify whether they still meet the specified requirements. In addition, wearing parts (e.g. seals) are regularly replaced within the context of preventive maintenance.

One key central precaution is the confinement of radioactive substances by several barriers connected in series. These may either be material barriers, such as the tank walls, the cell walls, the stainless steel canister and the vitreous matrix, as well as the outer building, or process engineering barriers, such as directed airflows of the waste air from the room and cells caused by pressure differences.

The number and technical design of the barriers are tailored to the nature (solid, liquid, gaseous) and activity inventory of the substances to be retained.

The efficiency of the barriers is monitored in the cells, work rooms and operating rooms by devices for the detection of leakages, pressure deviations and airborne radioactivity in the cells.

The planned decommissioning of VEK following vitrification of the stored HAWC solutions is described in the safety report.

Safety of Facilities for the Treatment and Storage of Wastes with Negligible Heat Generation

The confinement of radioactive substances during the storage of radioactive waste is ensured by a system of technical barriers and supplementary measures. This can be achieved with a variety of different approaches and may include, for example, integration into the matrix of the waste product, confinement in waste containers or, where applicable, the barrier function of buildings and ventilation systems with retention devices. Overall, safe enclosure can be achieved by one barrier or the combined effects of several barriers.

Facilities for the interim storage of radioactive waste with negligible heat generation and residual waste are designed, *inter alia*, for the handling and storage of sealed radioactive substances – in other words, the waste packages perform the function of safe activity confinement. In order to comply with the corresponding specifications, the waste packages are subjected to product control. This is ensured by means of monitoring and supervision.

Within the context of analysing hazardous incidents, external impacts are also taken into consideration. On this basis, the authority decides which precautionary measures are to be taken for the facility.

Safety of State Collecting Facilities

Under Section 9a of the Atomic Energy Act [1A-3], the individual *Länder* (Federal States) are required to establish State collecting facilities (*Landessammelstellen*) for the interim storage of radioactive wastes from research, industry and medicine arising on their territories. Handling and deviations from the handling specified in the licensing documents (Appendix II, Part A of the Radiation Protection Ordinance) are subject to licensing by the competent authority of the Land (Federal State) under Section 7 of the Radiation Protection Ordinance.

Sections 72 and 73 of the Radiation Protection Ordinance specify a comprehensive duty of declaration for State collecting facilities, together with forecasts of the quantity of wastes arising , and notification of the competent authority. The data must be managed on the basis of individual waste packages using computer-assisted data acquisition systems.

An application to the State collecting facilities for the delivery of radioactive wastes must be submitted in writing by the delivering party and accompanied by a waybill. On the basis of these documents, checks are made to ascertain whether the preconditions for acceptance of the radioactive waste have been met. The acceptance criteria of the State collecting facilities differ from one *Land* to another, and are laid down in the respective regulations for use. They depend on the respective licensing situation, and on the availability of conditioning equipment. Recommendations for the interim storage of low- and medium-activity wastes are contained in [4-3] (cf. the comments on Article 15). These recommendations include visual inspection of the outer surfaces of certain waste packages, and separate storage and repeated checks with visual inspection for unconditioned wastes. Safety-related findings must be notified to the *Land* authority responsible for the interim storage.

If the radioactive wastes fail to meet the preconditions stipulated in the respective regulations for use of the State collecting facility, the latter may refuse to accept them, and will report this to the supervisory authority responsible for the delivering party. In such cases, the wastes will remain in the hands of the delivering party until transformed into a condition conforming to the regulations for use, and the State collecting facility is willing to accept it. Alternatively, the radioactive wastes may be delivered by special agreement, subject to the consent of the competent supervisory authority. After acceptance, a further incoming inspection is performed to verify once again that the acceptance criteria have been met.

The acceptance criteria must be adapted in line with the latest state of the art in science and technology.

Each year, the individual operators of State collecting facilities hold a meeting for the purpose of exchanging information.

Article 12

(ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.

In Germany, past practices as defined by this Convention, such as the use of radium in the production of luminous paint or of thorium in the manufacture of gas mantles etc. in the first half of the twentieth century resulted in a number of individual sites which were contaminated to a limited extent. These contaminated sites have been or are currently being cleaned up and redeveloped for radiological and other reasons. Compared with the environmental legacy of uranium mining by the WISMUT company in Saxony and Thuringia, however, these sites only present comparatively minor problems. This section will therefore focus on the environmental legacies of uranium mining.

In large areas of Saxony and Thuringia, the geological formations permitted the surface and underground mining of uranium ore. Disused facilities of the former Soviet-German company WISMUT are located at numerous sites where ore was mined and processed from 1946 until the early 1990s. Most recently, mining took place in underground mines, but there are also some older open pits. In the proximity of the mining operations, the ore was processed into an intermediate product which was easy to transport. Up until 1990, uranium production totalled approximately 200000 t, making the Wismut company one of the world’s leading producers.

In the course of German reunification, the Soviet holdings in WISMUT were taken over by the Federal Republic of Germany, and the closure of the WISMUT facilities was initiated. During the course of this process, the extent of environmental damage and the remediation work required became clear. Uranium mining and processing not only caused considerable surface damage and direct consequences of the mining work; what is more, it also gave rise to large quantities of radioactive and chemically toxic residues which had been disposed of above ground in mill-tailing ponds and on heaps.

All mining and processing facilities have since been closed and are now in the process of dismantling as part of a comprehensive remediation concept encompassing all WISMUT sites. Heaps and mill-tailing ponds are being converted into a long-term stable condition. All installations and facilities have been affiliated to the technical department of WISMUT GmbH, which has been fully state-owned since 1992 and which falls under the jurisdiction of the Federal Ministry for the Economy and Employment.

Overall, the remediation issues are very complex and without precedent. The premises requiring remediation cover a total area of more than 30 km², with heaps accounting for a total area of approximately 15.5 km², and tailing ponds in which the tailings resulting from uranium production are stored in the form of sludge covering some 6.3 km² (with a total stored mass of around 160 million tonnes).

The first step in establishing the overall remediation concept was to draw up a comprehensive inventory. The overall remediation concept comprises all mining sites and all processing facilities (in which the uranium ore was converted to “Yellowcake”, an interim product more suitable for transport), including all appertaining areas, particularly heaps, tailing ponds etc. Furthermore, when formulating an overall concept, it was important to bear in mind that the sites are located in close proximity to human settlements and that priority action to reduce the dosage levels of the local population should not impede any later remediation work. The entire hydrology and hydrogeology also played an important role. In order to determine the optimum sequence in which individual sites should be remediated, they were classified into four categories according to the prevailing dose level. The sites with the highest dose levels require immediate action, whilst those in the second category require action in the medium-term and must be secured until remediation is completed. On the other hand, sites in the third and fourth categories have been or will be released for restricted or unrestricted use.

The overall concept for the remediation is essentially structured as follows:

- The underground mineworks (drifts and shafts) are partially backfilled.
- The mineworks will subsequently be flooded by discontinuing the current measures to lower the groundwater table. This process may take a few years or several decades, depending on the site and the geological conditions.
- The open pit at the Ronneburg site, which had an initial open volume of nearly 100 million m^3 at the start of the works, is being filled with material from the adjacent heaps. The material sequence and stratification has been optimised by means of hydrogeological and geochemical assessments. The pit will be flooded by discontinuing the current measures to lower the groundwater table.
- At many other sites, long-term measures will be necessary in order to treat the surfacing groundwater during and after the flooding process. It is estimated that it will be necessary to maintain these measures over long periods of time.
- The tailing ponds of the processing facilities will be kept in situ, i.e. there are no plans to relocate the tailings. The covering layer of water is removed and the exposed edges are successively covered in order to prevent the creation of dust. The remaining sludge is drained to allow the construction of a stable cover which minimizes the infiltration of rain water and the release of radon. Dams and ponds are reshaped in order to increase stability and blend in with the landscape.
- For the most part, the buildings of the various plants are dismantled. The building rubble is incorporated into the open pit as well as into heaps and tailing ponds. The bulk of the metal scrap is recycled by melting.

All of the aforementioned work has already commenced and varying degrees of progress have been made, depending on the individual site. The prompt implementation of these measures will take 15 to 20 years in total, depending on the site.

When determining the correct approach for remediation of these sites, it is always necessary to assess the net benefit which a planned remediation measure will provide in terms of the radiological contamination and other risks. The evaluation yardsticks used for this purpose include the maximum individual doses and the collective dose.

Article 13 (Siting of proposed facilities)

Article 13

1. *Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:*
   - *(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;*
   - *(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;*
   - *(iii) to make information on the safety of such a facility available to members of the public;*
   - *(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.*
2. *In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.*

The siting process outlined in Article 13 refers to proposed radioactive waste management facilities and repositories. These types of facilities are addressed separately in the following two sub-sections. As the information required under Article 13 1., numbers i to iv has already been given in other sections of this report, the relevant information is merely summarized here and reference is made to the appropriate sections.

Siting of Proposed Radioactive Waste Management Facilities

According to Section 7 of the Radiation Protection Ordinance (StrlSchV) [1A-8], a licence is required for the handling of radioactive substances in radioactive waste management facilities, depending on the nature of the facility. In contrast to spent fuel management facilities as described in the remarks on Article 6 of this Convention, this licensing procedure is not regulated by the Nuclear Licensing Procedures Ordinance (AtVfV) [1A-10].

The licensing requirements which must be met by such a facility are described in Section 9, para. (1) of the StrlSchV. With respect to the siting of such facilities, the following licensing requirements are particularly relevant:

- the necessary protection must be ensured against disruptive action or other interference by third parties,
- the choice of the site must not conflict with overriding public interests, particularly in view of its environmental impacts.

The required documentation and information depends on the type of facility and in particular on whether or not an environmental impact assessment (EIA) is necessary. According to Appendix 1 of the Environmental Impact Assessment Act (UVPG) [1B-14], an EIA is required for:

- 11.3: Construction and operation of a facility or installation for the handling or management of irradiated fuel elements or highly radioactive waste.

By contrast, the following facilities or installations (see Appendix 1 of the UVPG) require a general preliminary assessment of each individual case according to Section 3c, para. 1 of the UVPG:

- 11.4: Construction and operation of a facility or installation for the storage, handling or treatment of radioactive waste where the activities reach or exceed those limits laid down in an ordinance promulgated on the basis of the Atomic Energy Act (AtG) [1A-3] and compliance with such limits does not require any measures for mitigating the consequences of deviations from specified normal operation (according to Section 50 of the Radiation Protection Ordinance, such activities are defined as 10^7 times the exemption levels as specified in Appendix III, Table 1, column 2 of the StrlSchV in the case of unsealed radioactive substances and 10^{10} times the exemption levels as specified in Appendix III, Table 1, column 2 of the StrlSchV in the case of sealed radioactive substances).

This general preliminary assessment includes a rough review of the individual case with respect to potential substantial negative environmental impacts, with due regard for the criteria listed in Appendix 2 of the UVPG (including characteristics of the project, site, possible effects). Based on the outcome of this preliminary assessment, the competent authority will determine whether or not an environmental impact assessment is required.

Where the cases listed above pertain to the planned radioactive waste management facility or installation and if an EIA is required for the facilities or installations listed in point 11.4, then the type of information outlined in the remarks on Article 6 1. (i) and (ii) must be provided. This also implies the involvement of the general public in accordance with Section 9 of the UVPG (cf. the remarks on Article 6 1. (iii)) as well as the participation of other authorities and, where applicable, the participation of authorities of other countries as specified in Sections 7 and 8 of the UVPG (cf. the remarks on Article 6 1. (iv)).

Site Planning for Disposal

According to Section 9b of the Atomic Energy Act (AtG), the plan approval procedure for a repository is to be carried out with due regard for the relevant provisions of the Nuclear Licensing Provisions Ordinance (AtVfV). The licensing procedure according to nuclear law in connection with the required environmental impact assessment ensures that the requirements of Article 13 are met (cf. the remarks on Article 6 (i) to (iv)).

In February 1999, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) established the *Arbeitskreis Auswahlverfahren Endlagerstandorte AkEnd* (Committee on a Site Selection Procedure for Repository Sites, hereinafter referred to as “the Committee”) in order to lay down criteria for the identification of sites that are both suitable for safe disposal and at the same time accepted by the general public. The Committee’s recommendations serve to provide the Federal Government with a proposal on how the repository site selection procedure should be structured in accordance with the coalition agreement of 2002, to enable the Federal Government to meet its responsibility to establish facilities for the disposal of radioactive waste in accordance with Section 9a, para. 3 of the AtG. The Committee was given the task of developing a logical procedure for the selection of sites for the disposal of all types of radioactive waste in Germany. The procedure developed by the Committee provides well-founded criteria for site selection and incorporates the participation of the general public. Even at the development stage, the Committee discussed the results of its work with national and international experts and with interested segments of the general public.

The selection procedure proposed by the Committee envisages a step-by-step process whereby areas, site regions and finally sites that provide particularly favourable conditions for subsequent proof of suitability and confirmation in a licensing procedure are determined on the basis of pre-determined criteria.

The selection procedure developed by the Committee essentially comprises two elements. The first consists of selection criteria that comply with the international state of the art in science and technology and which must admit the identification and selection of suitable sites throughout the entire territory of Germany. The second element consists of a concept for the broad involvement of the general public in all key stages of the search and selection procedure.

Apart from developing suitable site selection criteria, the Committee has also drawn up proposals for a practical procedure to involve the general public (Phase I). This procedure is to be applied in the subsequent Phases II (negotiation and determination of the procedure) and III (concrete site search and specification).

Phase I: Development of a procedure (Mandate of the Committee)
In this phase, the Committee developed a site selection procedure. Interested members of the general public were notified via various channels, including the Internet, and participated in the debate. Discourse with public experts took place within the context of talks, lectures and publications. The Committee presented its results to a broad public at annual workshops. The results of Phase I were compiled in the form of a report [AKEnd 02].

Phase II: Specification of the procedure
The objective of this phase is the political / legal embodiment of the site selection procedure. During this phase, the criteria and procedure proposals developed by the Committee will be discussed with public experts and those involved in the subsequent site selection procedure (including environmental organisations, the energy industry, authorities and politicians) in a framework that satisfies the criteria of specialist, societal and political representativeness and legitimacy. A broad societal and political consensus on the subsequent site selection procedure will be an essential outcome of this phase. Phase II will also incorporate an international review of the results from phase I.

Phase III: Implementation of the procedure
During this phase, the selection procedure will be carried out with the representative involvement of societal and political forces, with increasing reference to region and site.

With respect to the current status, therefore, the requirements of Article 13 have been met.

Article 14 (Design and construction of facilities)

Article 14

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

Article 14

(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

Regarding the design and construction of radioactive waste management facilities, both the requirements of relevant acts and ordinances (such as the Atomic Energy Act (AtG) [1A-3] and the Radiation Protection Ordinance (StrlSchV) [1A-8]), and the content and recommendations of substatutory rules and regulations are duly taken into account and applied with regard to radiological aspects (e.g. KTA 1301.1; see enclosed list of KTA nuclear safety standards).

The realisation of these requirements creates the prerequisites for compliance with the radiation exposure limits for persons in Categories A and B who are exposed to radiation by virtue of their occupation, as well as for the population in the surrounding area during operation of the facility, as stipulated in the Radiation Protection Ordinance.

Radiological Protection of Operating Personnel

The measures to ensure the radiological protection of operating personnel which must be taken into account during the design and construction of facilities for the treatment of radioactive waste refer, in particular, to structural measures regarding the arrangement and design of the rooms in the controlled area of the facility. In this respect, the emphasis is on the arrangement and accessibility of the rooms, the arrangement and accessibility of the containers, the design of the wall and floor surfaces from the point of view of shielding, the decontaminability of the wall and floor surfaces, and the space requirement for tasks related to radiation protection, as well as the design of the entry and exit of the controlled area (including facilities for issuing work and protective clothing, washing facilities for the personnel, and facilities for contamination control before leaving the controlled area). The system design and the ventilation concept, the storage concept, the measurement methods for radiation protection monitoring within the controlled area of the facility (local dose rate, air activity concentration, surface contamination) and monitoring of the internal and external radiation exposure of personnel are additional aspects which must be taken into account during the design and construction of facilities for the treatment of radioactive waste and in the licensing procedure by the competent authority.

Radiological Protection of the Population during Specified Normal Operation

The radiological protection of the population during specified normal operation is ensured during the planning and construction of radioactive waste management facilities by their structural and technical design. In addition to shielding of the walls of the controlled area already mentioned above under the aspect of radiological protection of operating personnel, which also serves to limit direct radiation at the site and in the vicinity of the facility in accordance with Section 46 of the Radiation Protection Ordinance (StrlSchV), appropriate technical equipment must also be provided to limit the release of radioactive substances with air or water, in order to comply with the limits specified in Section 47, para. 1 of the StrlSchV for individual members of the local population in the vicinity of the facility. Such equipment comprises retention devices for airborne radioactive substances, as well as treatment facilities for contaminated waters and transfer tanks for waters from the controlled area. Moreover, the prerequisites for the measurement of releases and their nuclide-specific balancing are ensured by means of corresponding measurement, sampling and analysis methods.

Radiological Protection of the Population in Case of an Accident or Hazardous Incident

In accordance with Section 50 of the Radiation Protection Ordinance (StrlSchV), the conceptual planning of a radioactive waste management facility (interim storage facility, conditioning facility) includes structural and technical protective measures, with due regard for the potential extent of any damages, to limit radiation exposure caused by the release of radioactive substances into the environment in case of an accident or hazardous incident. The licensing authority defines nature and scope of the protective measures with reference to each individual case, particularly with regard to the hazard potential of the facility and the likelihood of an incident or accident occurring.

According to Section 49 of the StrlSchV, the design of structural or other technical measures to protect against incidents in or around a repository for radioactive waste must be based on a maximum effective dose of 50 mSv caused by the release of radioactive substances into the environment in the least favourable case. This requirement remains applicable until decommissioning. Individual dose limits are to be applied for specified organs. Further details can be found in Table F–1. The state of the art in science and technology is decisive for the adequacy of precautionary measures against accidents.

At the same time, the measures to protect the population against radiation also serve to ensure the protection of the environment.

Article 14

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;

The decommissioning of radioactive waste management facilities is taken into account at the design stage and during their construction, thanks to the analogous application of the stipulations and recommendations contained in the statutory and substatutory rules and regulations on the decommissioning of nuclear installations (cf. also [3-73]). With regard to facilities for the dry storage of HAW canisters, Guidelines [4-2] must also be applied. These guidelines state that an interim storage facility must be designed and executed in such a way that it can either be decommissioned or reused or removed in compliance with the radiological protection regulations.

Regarding the planning and construction of radioactive waste management facilities, the design ensures that the decommissioning of these facilities takes place with due regard for the radiological protection of operating personnel and adherence to the radiological protection regulations. In particular, structural prerequisites must be created in order to ensure the use of specific decontamination and dismantling methods, including remote-controlled methods, during the subsequent decommissioning of the facility.

For this reason, a corresponding decommissioning concept must be available at the design and construction stage of the facility. This concept includes specifications regarding the intended decommissioning option, which depends primarily on whether the radioactive waste management facility is being be constructed as part of a major nuclear installation, thus being integrated into decommissioning procedure of this facility, or whether it constitutes a separate site, thus entailing an independent decommissioning procedure directly related to this facility. Further decisive parameters of the decommissioning concept are determined by the composition of the wastes treated at the facility, in particular by whether or not it involves wastes containing nuclear fuel.

Within the context of the decommissioning concept, the operator defines the decommissioning procedure, assuming that any residual quantities of the wastes treated at the facility have been removed beforehand. The decommissioning concept also incorporates the requirements with regard to decontamination and dismantling methods and thus the radiological protection of the personnel. Since activation by neutrons can be virtually excluded, these requirements primarily result from the contamination of components. In this respect, however, it is important to consider that during treatment of fuel-containing wastes or wastes with other alpha-emitters, contamination from alpha-emitting nuclides is also present.

The requirements relating to the proposed decontamination methods take into account the minimisation of individual and collective doses to achieve a condition adequate for the performance of decommissioning work, as well as the reduction of volume and the recovery of residues as harmlessly as possible, with due regard for the secondary waste generated.

The requirements relating to the dismantling methods depend on the technological task (material, size of the components, environmental conditions, accessibility), the radiation protection conditions (existing activity, potential for aerosol formation, risk of contamination, confinement of mobile activity, limitation of the individual and collective dose), and the intended subsequent treatment in the form of residual waste for reuse, conventional disposal, or disposal as radioactive waste.

The decommissioning of the Karlsruhe Vitrification Plant (VEK), which is currently under construction, will be achieved primarily using the equipment required for operation and has already been incorporated into the design of the facility. The planned steps and measures for decommissioning of the facility were described by the applicant in his licensing documents.

Article 14
(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;

Upon termination of the operational phase, a repository in deep geological formations must be safely sealed against the biosphere in the long term.

As a licensing prerequisite, Section 9b, para. 4 of the Atomic Energy Act (AtG) in connection with Section 7, para. 2, subpara. 3 stipulates that “the necessary precautions have been taken in the light of the state of the art in science and technology to prevent damage resulting from the erection and operation of the installation”. Regarding nuclear safety, the Safety Criteria [3-13] for the Permanent Storage of Radioactive Waste in a Mine of 1983 formulate this requirement in more concrete terms:

“After closure, radionuclides which could reach the biosphere as a result of transport processes from a sealed repository which cannot be completely excluded must not lead to individual doses that exceed the levels stipulated in section 45 of the Radiation Protection Ordinance.” Section 45 of the former version of the Radiation Protection Ordinance (now Section 47 of the Radiation Protection Ordinance of July 2001) limits the annual radiation exposure of individual members of the general public caused by discharges of radioactive materials with air or water from nuclear facilities or installations. The Ordinance does not stipulate expressly any limits for radiation exposure caused by radioactive material released from a repository in its post-closure phase. For this reason, when conducting site-specific investigations into long-term safety, procedures are based on Section 47 of the Radiation Protection Ordinance.

Due to requirements in other legal areas, it is necessary to ensure that damaging environmental impacts are avoided or limited to the bare minimum. Mining law requires that there must be no long-term subsidence on the surface which could have inadmissible consequences for protected commodities. Water legislation stipulates that there must be no reason to fear harmful pollution of groundwater or any other detrimental change to its characteristics.

In order to meet the aforementioned requirements, it is necessary to take into account the respective situation of the repository, such as the natural (geological) and any technical barriers which may be required, the rock-mechanic characteristics of the host rock (such as convergence), the inventory, the emplacement technique and the backfill materials. With the aid of a comprehensive site-specific long-term safety analysis including scenario analyses, it is necessary to demonstrate that the closure measures avoid any inadmissible effects caused by the release of radioactive material and non-radioactive chemotoxic components of the waste packages and backfill materials, as well as subsidence on the surface.

For this reason, within the context of a plan approval procedure for a repository mine, the long-term safety analyses make allowance for backfilling and sealing. The measures to be taken upon cessation of emplacement operations are specified. The supervisory authority monitors the nature and manner of execution.

To date in the Federal Republic of Germany, no repository in deep geological formations has undergone backfilling respectively closure. Plans in this respect for the Konrad mine as a repository for radioactive waste with negligible heat generation were filed and approved within the scope of the licensing procedure concluded in May 2002. Concrete details of the measures required in order to comply with the protection targets following the cessation of emplacement operations have not yet been finalised. Since closure does not generally take place for several decades, such details must be specified according to the valid state of the art in science and technology existing at that time within the context of separate procedures encompassing the requirements of both nuclear legislation, mining and water legislation, as well as other legal requirements.

The Morsleben repository was designed and commissioned in the former GDR. In 1989, a closure concept was developed which entailed the scheduled flooding of the mine. After the Morsleben repository had been taken over as a Federal repository in the wake of German reunification, knowledge gleaned from operation and from targeted geological, geotechnical, geochemical and mining investigations was used to develop a new closure concept. These backfilling and sealing measures are designed to stabilise the mine structure and to seal the emplaced waste in such a way that the protection targets outlined in the Atomic Energy Act (AtG) are met. The closure concept for the Morsleben repository is subject to licensing in the form of a plan approval procedure.

Article 14

(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

There is no difference between the requirements governing the technologies applied to the design and construction of radioactive waste management facilities and those for facilities for the treatment of spent fuel assemblies. As such, the remarks on Article 7 (iii) apply in full to Article 14 (iv).

Article 15 (Assessment of safety of facilities)

Article 15

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

Article 15

(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

Assessment of the safety of radioactive waste management facilities (interim storage facilities for radioactive wastes, and vitrification and other conditioning facilities), and the assessment of environmental impacts prior to construction of such a facility, are carried out as part of a licensing procedure (cf. the remarks on Article 19).

Under Section 7 of the Radiation Protection Ordinance (StrlSchV) [1A-8], the handling of radioactive materials in nuclear facilities for the management of radioactive wastes requires a licence. The erection of vitrification facilities must be licensed in accordance with Section 7 of the Atomic Energy Act (AtG) [1A-3], since nuclear fuels will be treated or processed in such facilities. The essential features of the safety assessment in the licensing procedure pursuant to Section 7 of the AtG are outlined in the remarks on Article 8, and apply *mutatis mutandis* to the licensing procedure for facilities for the vitrification of highly radioactive wastes.

Whereas the licence pursuant to Section 7 of the AtG combines the licences required for the erection and operation of the nuclear facility and for the handling of nuclear fuels (cf. the remarks on Article 8), Section 7 of the Radiation Protection Ordinance regulates only the handling of radioactive materials. A building permit under the applicable building code must also be applied for.

Applications for licences under the Atomic Energy Act must be submitted to the respective competent authority of the *Land* (Federal State). The application must outline the extent to which the nuclear facility possesses the required safety characteristics, and conforms to the specifications of the applicable rules and regulations. In the licensing procedure under Section 7 of the Radiation Protection Ordinance (StrlSchV), the documents listed in Appendix II, Part A, of that Ordinance must be enclosed with the licence application. The preconditions for a licence for handling radioactive materials are governed by Section 9 of the StrlSchV. They are described in detail in the remarks on Article 13.

According to Section 12b of the Atomic Energy Act, the competent authorities are required to investigate the reliability of the persons responsible for the handling of radioactive materials, in accordance with the Reliability Assessment Ordinance (*Atomrechtliche Zuverlässigkeitsüberprüfungs-Regulation = AtZüV*) [1A-19], so as to safeguard against unauthorized actions that might lead to a misappropriation or substantial release of radioactive materials.

The standards of the Nuclear Safety Standards Commission (*KTA*) and the German Standards Institute & German Association of Electrical Engineers (DIN/VDE) are to be used as the basis for checking the licensing requirements, and are to be applied *mutatis mutandis*. During the course of verifying the licensing requirements, the competent licensing authority may call upon the services of independent experts in accordance with Section 20 of the Atomic Energy Act.

By specifying the possibility of retrospective conditions being imposed in the handling licence, the competent authority may demand adaptations in line with the state of the art during the service life of the facility.

According to the Environmental Impact Assessment Act (UVPG) [1B-14], an environmental impact assessment is mandatory for nuclear facilities designed to store radioactive wastes for more than ten years at a location other than that where they were generated, and for nuclear facilities requiring a licence under Section 7 of the Atomic Energy Act (AtG). The Environmental Impact Assessment Act does not apply to licensing procedures commenced prior to 3 July 1988 (Section 25, UVPG). More information on the EIA Act can be found in the remarks on Article 13 and Article 6.

In addition, the Environmental Impact Assessment Act provides for general screening of individual cases in the case of nuclear facilities for the storage, handling, or processing of radioactive wastes whose activity reaches or exceeds specified values. For such facilities, an environmental impact assessment must be performed if the competent authority feels that the project may have substantial adverse environmental impacts.

The Reactor Safety Commission is currently drafting safety requirements for the longer-term interim storage of low- and medium-activity radioactive wastes. The basic aspects of the requirements and recommendations are outlined in an RSK recommendation [4-3]. In future, the safety of a radioactive-waste management facility and its environmental impacts will be assessed on the basis of these criteria.

Facilities for the interim storage of radioactive wastes are usually designed for handling and storing enclosed radioactive materials. The waste containers therefore perform the task of secure containment of the radioactivity for the entire period of storage. A storage facility may also be designed to handle open radioactive materials, but this requires additional engineering arrangements with regard to the assumed discharges of radioactive materials in vent air and waste water.

According to [4-3], the requirements which must be observed for the long term interim storage of wastes with negligible heat generation include the following:

- The waste products must not generate quantities of gas that could lead to an unacceptable build-up of pressure in the waste packages, or the formation of flammable or detonable gas mixtures in a section of the depot.
- The waste products must not trigger any other physicochemical processes (such as the formation of acids) that could have a negative effect on the integrity of the containers. Their integrity must not be impaired by either mechanical damage or corrosion processes.
- If sealing systems are used in the containers for containment of the gaseous radioactive inventory, these must ensure retention of the radioactive inventory throughout the entire period of storage, or limit the emissions sufficiently. In-service inspections of the leak-tightness of the waste packages are to be performed on any packages with a significant inventory of volatile H-3 and C-14. If generation of gas cannot be excluded, the waste containers must be fitted with pressure-relief equipment. The possible release of toxic substances in design-basis incidents must be assessed in safety analyses.
- After longer-term interim storage, it must still be possible to handle the packages safely, they must be transportable, and must meet the final-disposal conditions in force at the time (after appropriate conditioning, if necessary).
- The wastes are to be documented in accordance with the provisions outlined in Section 73 of the Radiation Protection Ordinance (StrlSchV) and the guidelines of the Federal Environment Ministry (*BMU*) [3-59], and recorded in an electronic accounting system (waste flow control). Older waste packages that have not been documented shall be subjected to retrospective qualification. Sufficient allowance must be made for avoiding unnecessary exposure to radiation (Section 6 of the Radiation Protection Ordinance). Documentation of the waste packages shall be presented to the competent supervisory agency within one year of emplacement, unless alternative provisions are stipulated in the licence. It must be verified by an independent expert.
- A storage concept with and without access for inspections must be drawn up. The scope of visual inspections depends on the respective storage concept (type of container, composition of the waste product, opportunities for limiting humidity in the depot halls, waste packages not placed directly on the ground).

The feasibility in principle of decommissioning a radioactive-waste management facility is considered within the context of the licensing procedure. Decommissioning requires a licence under Section 9 of the Atomic Energy Act (AtG) or Section 7 of the Radiation Protection Ordinance (StrlSchV).

Article 15

(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;

Assessment of Safety before Construction of a Disposal Facility for the Period Following Closure

Section 9b as well as Section 7, para. 2, no. 3 of the Atomic Energy Act (AtG) stipulate that the necessary precautions must be taken according to the state of the art in science and technology to prevent damage from ionising radiation. These precautions are also pertinent to the period following closure of a repository. As the disposal of radioactive waste in Germany is defined as the maintenance-free, safe emplacement of these materials for an unlimited period of time, the long-term safety assessment is of particular importance within the licensing procedure.

The objective of radiation protection is based on the dose limits set out in Section 47 of the StrlSchV (cf. the remarks on Article 14 (iii)).

Evidence of compliance with the dose limits may be provided in the form of model calculations. These calculations are used to ascertain and quantify potential releases of radionuclides from the repository through the geosphere into the biosphere and to calculate the possible radiation exposure of humans using a variety of exposure scenarios and model assumptions. The input data for these models is derived from the characteristic data of the radioactive waste, a description of the deposition and technical barrier concept, and the geological data of the model area obtained from a site investigation. The dose is calculated with due regard for Section 47 of the StrlSchV and the associated General Administrative Provision [2-1]. Evidence is additionally based on an assessment of the overall geological situation of the site.

The current state of the art in science and technology is decisive when specifying a forecasting period for the required precautionary measures (isolation period). In other words, all relevant scientific and technological knowledge and experience must be taken into account. With the aid of a geo-scientific long-term forecast, an isolation potential of > 10^5 years has been calculated for the Schacht Konrad repository as a repository for radioactive waste with negligible heat generation.

Point 5.2 of the Safety Criteria for the Permanent Storage of Radioactive Waste in a Mine [3-13] stipulates that

> “.... site-specific safety analyses must be performed in accordance with scientific methods. Within the scope of the safety analysis, sub-systems and scenarios are emulated by means of suitable models using sufficiently conservative assumptions.”

This implies that releases of radionuclides and non-radioactive contaminants from the repository through the geosphere into the biosphere, as well as the resultant possible radiation exposure for humans and the effects on groundwater, must be evaluated and assessed within the context of model calculations.

Assessment of Impacts on the Environment

Section 9b of the Atomic Energy Act (AtG) stipulates that a plan approval procedure (licensing procedure) is mandatory for repositories for radioactive waste. The plan approval notice may only be granted if the prerequisites listed in the aforementioned section of the AtG have been met by the applicant (cf. the remarks on Article 4 (i) to (iv)). This also includes consideration of the common good and other provisions of public law, particularly with respect to the environmental impacts.

The Nuclear Licensing Procedures Ordinance (AtVfV) [1A-10] and the Administrative Procedures Act (VwVfG) regulate the design and implementation of the plan approval procedure. In addition, the Environmental Impact Assessment Act (UVPG) requires the performance of an environmental impact assessment.

Stipulating that the state of the art in science and technology is a prerequisite for the plan approval notice ensures that the safety assessments and the environmental impact assessment are up-to-date at the time of issuing the plan approval notice.

Article 15

(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

Under Section 19 of the Atomic Energy Act (AtG), the handling and trafficking of radioactive substances is subject to government supervision. An assessment of the safety and the environmental impacts prior to commissioning of the nuclear facility occurs within the context of supervision which accompanies construction under the Atomic Energy Act.

Material deviations from the handling specified in the licence documents require a permit under Section 7 of the Radiation Protection Ordinance (or Section 7 of the Atomic Energy Act in the case of vitrification facilities).

If an alteration to authorized handling requiring a permit arises during the course of construction of a waste-management facility ahead of its commissioning, a new licence application must be submitted with the necessary documents, whereupon the safety will likewise be reassessed. Where applicable in the case of projects requiring an environmental impact assessment under Section 3e of the Environmental Impact Assessment Act (UVPG), the assessment of environmental impacts must be repeated. If the alteration applied for could entail substantially altered impacts on affected sections of the general public, a repetition of the public participation measures as part of the environmental impact assessment will also be necessary.

Article 16 (Operation of facilities)

Facilities for waste management and storage must be constructed and operated in such a way that the required precautions against damage are taken in line with the state of the art in science and technology. This is ensured by nuclear licensing and supervision by the competent authorities. In particular, the following operating states are considered:

- specified normal operation,
- the identification and control of disturbances and incidents as well as the removal of their consequences,
- the early detection of detrimental changes regarding the retention properties of the waste products, the waste packages and the storage building.

Article 16

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

Article 16

(i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

Before commencing operation, all systems and equipment are subjected to commissioning tests. These tests are specified in a commissioning programme which ensures that the safety requirements outlined in Article 15 are met. The commissioning programme is subject to approval by the competent authority. The tests serve to demonstrate that the systems and equipment are qualified for the intended operation and can be operated as specified. The results are documented.

The overall operation must be suitably structured to ensure the safe performance of the operational processes. In particular, the administrative prerequisites regarding personnel, organisation and safety must be fulfilled. The authority supervises compliance with these prerequisites. Clear instructions must be drawn up in the form of an operating manual for operational processes, accident management and the removal of the consequences of incidents and accidents. Competencies and responsibilities must be clearly defined. The competent authority supervises compliance with these requirements.

Prior to initial emplacement or treatment of waste, the entire handling procedure, including the radiation protection measures, is tested. During the course of testing, any potential deficiencies in the procedure are identified. In this way, optimisations can be tested prior to handling the waste packages, and the envisaged procedures provided can be adapted and finalised.

Article 16

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary;

All operational processes and the measures to be taken in case of an incident or accident are outlined in an operating manual, or in the case of a repository, in a mine book/operating manual, in form of clear operating instructions. Particular attention is given to all aspects affecting safety. Furthermore, the procedure in case of modification or supplementation of components and processes must also be specified. This ensures that operatives are able to initiate and perform the necessary measures swiftly and competently in case of abnormal operation or incidents. This procedure is subject to regulatory supervision.

Article 16

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;

Regulatory supervision ensures observance of the procedures on operation, maintenance, monitoring, inspection and testing established in the nuclear licensing procedure for a radioactive waste management facility.

In particular, the wastes are subject to incoming inspection prior to any form of treatment or emplacement. The incoming inspection serves the purpose of verification and must facilitate the following evidence:

- Identification control: The incoming inspection verifies whether the wastes are the same as those declared for acceptance.
- Fulfilment of acceptance criteria: The incoming inspection ensures that the acceptance criteria defined in the licence are fulfilled. For this purpose, reference may also be made to the quality-assured data of the conditioner.
- Verification of the data stated by the delivering party: The incoming inspection checks specific waste parameters independently from the data supplied by the delivering party. Specific parameters may include, for example, mass, dose rate and surface contamination.

As a general rule, the following aspects are controlled for the purposes of emplacement operation:

- Mass, dose rate and surface contamination of the waste packages,
- Condition and labelling of the waste packages, and
- Compliance with declared data.

Furthermore, the following is also observed:

- In the case of non-compliance, extended controls are performed.
- The incoming inspections are only performed by trained personnel.
- Any disturbances and findings are reported immediately.

The emplacement is logged.

When removing waste from the storage facility, exit inspections are performed. Waste packages leaving the facility are subject to unequivocal identification. In addition, the removal of waste is also logged.

Execution provisions are developed for compliance with the acceptance criteria. These include operating instructions and test procedures which must be observed during handling of the packages.

At the site of the interim storage facility or management facility, adequate numbers of qualified personnel must be available to ensure fulfilment of the safety requirements, and must be subject to regular training. With regard to personnel, a distinction is made between the following cases:

- Management and storage facilities belonging to a nuclear installation which is either in operation or in the process of dismantling: in such cases, the personnel of the nuclear installation perform most functions.

- Management and storage facilities with permanent staffing covered by own personnel: these facilities are regarded as being independent with regard to operation.
- Management and storage facilities which do not require permanent staffing. The functions are restricted to deployment on demand in case of treatment, emplacement or removal operations, and/or regular inspections. The demand is temporary and is generally covered by personnel who primarily perform other tasks.

The technical qualification required for the respective position is demonstrated in accordance with the requirements of the Radiation Protection Ordinance (StrlSchV) or separate regulations. The requirements concerning responsibility for nuclear safety issues are regulated by the Atomic Energy Act (AtG) [1A-3] and the Radiation Protection Ordinance (StrlSchV) [1A-8]. The responsibilities and regulations on representation are defined unambiguously in the instruction manual.

Due regard is given to the development and promotion of a pronounced safety culture. This is particularly applicable to facilities where personnel activities are required relatively seldom or where changing personnel are deployed for different tasks. With regard to long-term operation of the storage facilities, it is assumed that changes of personnel are required. In this respect, measures are taken to ensure that the required personnel resources are available in order to maintain a sustainable safety culture. This is achieved by long-term personnel planning and careful planning with regard to the maintenance of experience.

Different emergency procedures may be required, depending on the type of management or storage facility and the wastes stored. Based on the possibilities for the release of radioactive substances from the storage facility, an on-site emergency preparedness plan is drawn up, co-ordinated and agreed, where applicable, with the emergency preparedness plans of neighbouring facilities and the competent local and regional authorities. Hard copies of the on-site emergency preparedness plan are always kept available at a permanently staffed location, Further copies are submitted to the neighbouring facilities, the competent authorities and safety bodies, where applicable.

Article 16

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

We have already reported on the measures to ensure engineering support during the facility's operating lifetime via the provision of adequate competent personnel in the comments on Article 22 (i).

Recurrent tests are performed on the safety-relevant systems and equipment of the facility, such as

- conditioning facilities,
- lifting devices,
- alarm systems,
- equipment and systems for radiation protection,
- ventilation systems, where applicable.

The frequency of such testing is determined according to the safety significance of the components to be checked. Typical testing intervals are one or two years. The recurrent tests are specified in a testing manual. The results of the recurrent tests are documented.

The technical equipment used for the handling of the packages and the transportation thereof must remain available until all packages have been removed. In this respect, it is assumed that removal of the packages, e.g. for the purposes of emplacement in a repository, may take place over a longer period of time. To this end,

- the necessary systems and equipment of the facility (e.g. lifting devices) are kept either in a state of operational readiness or in such a state that operational readiness can be restored in the short term (e.g. by a recurrent test),
- auxiliary equipment (e.g. overpacks, special lading devices) required for transport is kept available,
- necessary type approvals for the cask types are permanently maintained,
- the packages are maintained in a condition that generally facilitates approval under traffic law provisions, and
- any aids required for obtaining approval under transport law provisions are available (e.g. measuring and test devices, documentation).

All the systems and equipment of the facility requiring testing or maintenance must be readily accessible or made accessible by technical means. The spatial conditions are designed in such a way as to allow sufficient space for maintenance work, and any additional shieldings required for radiological protection reasons must be kept available. Regulations governing the preparation and performance of maintenance work are included in the operating manual.

Article 16

(v) procedures for characterization and segregation of radioactive waste are applied;

The sorting and segregation of the wastes and the preparation of associated documentation is performed initially by the waste generator or by the delivering party, respectively. If required, the waste management or storage facilities should be equipped with the necessary means for the sorting of wastes with due regard for all requirements relating to the radiological protection of personnel and the environment.

Article 16

(vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

The obligation of the licensee to report safety-relevant incidents to the regulatory body is based on the Nuclear Safety Officer and Reporting Ordinance (AtSMV).

Operation of the facility is monitored to ensure that any safety-relevant operational disturbances are reliably detected and the corrective measures specified in the instruction manual can be taken. Fault signals are recorded and documented centrally and, depending on the severity of the incident, reported to the authority in a timely manner. Safety-relevant findings from initial start-up, specified normal operation (particularly in the case of maintenance, inspection and repair) and in-service inspections are documented and submitted to the regulatory authority. Consequences derived from an evaluation of these incidents are incorporated into the operating procedures.

Article 16

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

In view of the obligation of the authorities to take precautionary action, reports of incidents significant to safety are registered and evaluated at the incident registration centre of the Federal Office for Radiation Protection.

Experiences from the operation of similar plants are taken into account by the plant management. This ensures that experiences, especially regarding

- the behaviour of package material,
- observations on gradual changes of the waste products,
- ageing phenomena at facility equipment,
- improvements to or deficiencies in the conditioning procedures,

are examined and evaluated with regard to their transferability. In this way, plant operation also makes adequate allowance for processes that occur very slowly as well as occurrences taking place rarely or only in case of certain wastes. Procedures are provided which ensure the exchange of experiences (e.g. on the basis of operating reports) between the operators on the one hand, and the competent licensing and supervisory authorities and the experts consulted by them on the other, at adequate intervals.

A monitoring concept is drawn up to allow the detection and control of long-term and ageing effects during the useful life of the storage facility. On the one hand, the monitoring concept includes an evaluation of results from previous inspections, including the experience from other facilities. On the other, it can also include special analyses that cannot be performed recurrently at regular intervals due to the effort involved and the slow speed of any anticipated detrimental changes.

The monitoring concept stipulates monitoring of the overall condition of the facility and the packages stored, and as a minimum requirement, must meet the following:

- At ten-year intervals, the licensee prepares regular reports on the condition of the storage building, the components required for storage and handling, and the waste packages. In particular, these reports should also incorporate the findings of in-service inspections. The reports include a prognosis on the continued storability of the packages and waste types, as well as on the further development of the relevant retention properties of the building.
- The condition of the storage building and the components necessary for interim storage are also subjected to a special inspection at intervals of ten years. As a minimum requirement, these should include walk-downs and appropriate measurements. In addition, recurrent subsidence measurements are performed on the storage building and evaluated with regard to long-term detrimental changes.

All operational measures, controls, inspections and modifications are subject to the supervision of the competent authorities.

Article 16

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

Radioactive waste management facilities are designed and constructed in a way that they can be decommissioned and either reused or removed in compliance with the radiation protection regulations. This proof is examined within the context of the licensing procedure. Prior to reuse or demolition of buildings, it is necessary to prove by means of measurements that these buildings are either not contaminated, or have been adequately decontaminated and are free of inadmissible activation. The requirements under building and waste management laws must also be observed.

Article 16

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

With respect to German repositories, official plan approval exists for the Konrad mine repository. This also stipulates regulations pertaining to the closure of the repository. The applicant (BfS) filed plans for the closure of both the mine openings and the shafts. Expert evaluation indicated that these plans conform to the current state of the art in science and technology.

The closure of the Morsleben repository is currently still at the planning stage. During this phase, all relevant information gleaned during the operational period is taken into consideration. For example, the closure concept incorporates findings from the geological, geotechnical, geochemical and mining fields.

The Atomic Energy Act (AtG) is applicable to the Morsleben repository, which is destined for closure and backfilling, as well as to the licensed Konrad repository. However, since these are either located or planned to be located in deep geological formations, they are also subject to mining law as well as the Atomic Energy Act. According to Section 55, para. 1 of the Federal Mining Act (BBergG) [1B-15], operational plans for the construction and management of a plant may only be approved if the required precautions to facilitate reutilisation of the surface have been taken into account to the extent required under the prevailing circumstances. Furthermore, the relevant Section 7, para. 2 of the General Mining Ordinance on Underground Mines, Open-Cast Mines and Salt Mines (ABVO) [ABVO 96] stipulates that open shafts maintained in a state which is neither safe nor descendable are to be backfilled. An application for such backfilling must be submitted in a timely manner in the form of an operational plan.

This aspect of mining legislation therefore ensures that at the time of filing the final operational plan – which may be many years in the future from the date of approval of operation – any new knowledge acquired in the interim period can be duly taken into account.

The licensing procedure under nuclear law stipulates that the “Safety Criteria for the Permanent Storage of Radioactive Waste in a Mine” [3-13] must be taken into account. This was the case in the licensing procedure for the Konrad mine repository. These safety criteria were likewise taken into account when preparing for the licensing procedure for the closure of the Morsleben repository. The safety criteria include provisions regulating closure under point 9, which states that a repository must be closed following the operational phase. Voids must be backfilled and sealed with suitable materials, using appropriate techniques, in order to increase stability by means of void reduction. As a general rule, the potential release of radionuclides must be limited to an admissible extent. Consequently, due regard for these guidelines ensures in the field of nuclear legislation that all necessary measures are planned prior to closure but may only be carried out after licensing.

The Asse research mine is not a repository and is therefore not subject to mandatory reporting. Although it is still used for research purposes, it has been removed from supervision under nuclear law and is only subject to mining law supervision. As such, it falls outside the scope of application of this Convention. Supervision under mining law also requires the keeping of comprehensive long-term safety records for closure of the Asse mine. The nuclear supervisory authority could become active once again on the basis of Section 19 of the Atomic Energy Act (AtG).

Article 17 (Institutional measures after closure)

Article 17

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

Article 17

(i) records of the location, design and inventory of that facility required by the regulatory body are preserved;

Official plan approval has only been issued for the Konrad repository. This also includes regulations governing the post-operational period following. A collateral clause stipulates that:

> Documentation must be provided during construction, operation and decommissioning of the repository, comprised of data relating to the mine survey of the repository, the characteristics of the wastes deposited (type, quantity, emplacement area, nuclide spectrum, activities), as well as the relevant technical measures. Full sets of documentation must be kept by the operator of the repository at a suitable place and must be duly protected. In addition, the operator must provide full sets of documentation for the atomic authority and for the competent mining office, respectively, which are to be kept under protection in separate locations. The sets of documentation kept by the supervisory authorities must be updated on an annual basis as long as the repository is operational or in the process of decommissioning. For the period following its closure, the form, extent and the storage locations (at least at two separate locations) of the long-term documentation must be specified in the closure plan (*Abschlussbetriebsplan*) and submitted to the supervisory authorities for approval.

The plan approval notice for the Konrad repository is not yet enforceable because it has been challenged before the courts. However, it can be assumed that the aforementioned regulations for the post-operation phase will act as a precedent for the Morsleben repository. This repository is being closed, and the required measures for backfilling and closure are currently being planned.

Article 17

(ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required;

The type of institutional control after closure is regulated in the licence for the Konrad repository as follows:

> No special control and surveillance programme is envisaged for the period following closure. However, routine measurements of the environmental media air, water and soil must be

conducted on the area surrounding the repository in accordance with the relevant regulations. These measurements must be examined for any evidence of impacts from the repository and documented in a suitable format. The extent and format must be specified in the closure plan (*Abschlussbetriebsplan*) and the results added to the long-term documentation.

As such, the required institutional controls are primarily limited to passive measures. Active measures are not envisaged in view of the design of the repository. Should the results from routine surveillance so require, counteractive action may be initiated by means of intervention on the part of the authorities.

Article 17

(iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

As outlined in the remarks on Article 17 (ii), no special control or surveillance measures are required following the closure of a repository in deep geological formations. The usual inspection of surface settlement is carried out within the regime of mining law. The routine measurements of air, water and soil samples are likewise carried out in the area surrounding a repository, in accordance with legal requirements. In this way, any unplanned releases of radioactive substances may be detected and any measures which may be required by the competent authorities in order to avoid or mitigate any hazards can then be initiated. Collateral clauses in the plan approval for the Konrad repository stipulate that routine surveillance data must likewise be evaluated in this respect. The closure of the Morsleben repository (ERAM) is currently in the planning phase, and therefore plan approval is not yet available. However, the routine surveillance programme as stipulated in the regulations must also be carried out for this site.

Section I. Transboundary Movement

Article 27 (Transboundary movement)

Article 27

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

Transboundary movements of spent fuel elements and radioactive waste are subject to licensing in Germany. Current German legislation requires that the delivering party (i.e. exporter) must submit an application to the competent authority (the Federal Office of Economics and Export Control (BAFA)) for each shipment of these materials. The BAFA must determine whether all legal provisions have been met and if so, grants the licence and subsequently monitors compliance with the legal requirements during each individual shipment. In principle, a licence for a given quantity of material may be used for several individual shipments of partial amounts. In the case of shipment of radioactive waste from other EU states to Germany, the licensing authority in the delivering country shall be responsible; however, the BAFA is also consulted.

Transboundary movements of spent fuel elements and radioactive waste will only be authorized if compliance with the safety measures outlined in the comments on Articles 4 to 17 and 21 to 26 is ensured, and compliance with the provisions of international conventions has been checked.

Article 27 1.

In so doing:

Article 27 1.

(i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

Spent Fuel Elements

In the case of spent fuel elements, a licence according to Section 3 of the German Atomic Energy Act (AtG) [1A-3] is required for all transboundary movements; the competent authority is the BAFA. Such a licence will only be granted if there are no concerns regarding the applicant's reliability. Above and beyond this, it is necessary to ensure that in the case of shipments into Germany, the nuclear fuel is handled in accordance with the provisions outlined in the AtG, the statutory regulations adopted on the basis of this Act, and Germany's international obligations in the field of nuclear power (Section 3, Paragraph 2 of the AtG).

Similarly, in the case of shipments out of Germany, it is additionally necessary to ensure that the nuclear fuel will not be used in a manner that endangers Germany's international obligations in the field of nuclear power or its internal or external security (Section 3, Paragraph 3 of the AtG).

Observance of these additional provisions is checked on the basis of contracts and declarations which must be submitted. Within the context of parallel supervision of a material's movements by

EURATOM, to whom monthly reports must be submitted, the correctness of which is verified by inspectors on a regular basis, notification also occurs prior to each individual shipment.

Official confirmations from the State of destination, where this is an EU member state, are not obtained directly for each individual shipment. Instead, these were issued in advance upon signing the reprocessing contracts between the Governments of France, the UK and Germany.

In the case of return deliveries e.g. of spent fuel elements from research reactors back to the USA, export cannot take place until an official import certificate has been received from United States. For all other countries, an exchange of notes takes place between the affected government prior to the delivery, as part of the licensing procedure under foreign trade law.

The ongoing shipments themselves are supervised by the competent authorities of the individual *Länder* (Federal States); partial deliveries are reported both to EURATOM and to the BAFA on a monthly basis. These reports to the BAFA will be processed first by the customs authorities in the case of consignments to and from countries which are not members of the European Communities.

Radioactive Waste

Each transboundary movement of radioactive waste is subject to the provisions of Directive 92/3/EURATOM [EUR 92]. This Directive was transformed into national law with the Ordinance on the Transboundary Movement of Radioactive Waste (AtAV) [1A-18], which primarily comprises the following provisions:

Transboundary movement within the European Community

The holder of radioactive waste applies to the competent authority in his country (in Germany, this is the BAFA) for a licence. There is a standard form available for this purpose, which is divided into different sections. Section 1 is the application form. The competent authority forwards a copy of this section together with section 2 ("Approval of the consulted competent authority") to this competent authority in the State of destination (which in the case of shipments to Germany is the BAFA). This section 2 is only approved by the BAFA and mailed back to the competent licensing authority provided both the consignee and his competent supervising authority have likewise given their consent to the proposed shipment. Section 3, the licence itself, can then be issued and handed over to the applicant.

During a shipment, all documents must be carried, including section 4 (“loading list“) and 5 ("acknowledgement of receipt"). In the case of transportation by rail, all the aforementioned documents must be transmitted to all affected authorities in advance of each shipment. In order to ensure that all affected authorities are informed about every shipment, and to enable them to log the quantities delivered, they regularly receive copies of the respective sections 4 and 5.

Transboundary movement to or from states which are not members of the European Community (third countries):

In the case of shipments from Germany to a third country, the BAFA will only grant a licence to the holder of the radioactive waste provided the competent authority of that third country has confirmed to the BAFA that the consignee holds the necessary licence and the necessary equipment to handle such radioactive waste, and it has been proven that the respective specified criteria for the export of radioactive waste to third countries have been met.

In case of a shipment from a third country to Germany, the consignee is the applicant, and will only receive a licence from the BAFA provided he holds the necessary licence and the necessary equipment to handle such radioactive waste or has notified such handling in accordance with an existing obligation.

Article 27 1.

(ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

In the case of transit through Germany of spent fuel elements, which are not radioactive waste and therefore do not fall under the provisions of the AtAV, the BAFA is not involved. Supervision of the transit such spent fuel elements is the responsibility of the Federal Office for Radiation Protection (BfS), and in the case of transportation by rail, the Federal Office for Railways (EBA).

In the case of transit of radioactive waste, the BAFA must be consulted under the provisions of Directive 92/3/EURATOM [EUR 92] or of the AtAV; the transit therefore is subject to approval. Such approval will only be granted if there are no facts leading to concerns vis-à-vis proper delivery to the country of destination.

Article 27 1.

(iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;

Transboundary movements of spent fuel elements and of radioactive waste will only be licensed by the expert staff at Germany's competent authority, the BAFA, provided the consignee in Germany ensures that such materials conform to the safety measures outlined in the comments on Articles 4 to 17 and 21 to 26. Prior to receiving such material, the consignee must apply to the BAFA for a licence under the statutory provisions outlined in with respect to Article 27 1. (i). The BAFA will verify compliance with these provisions. Under EU law, this procedure does not apply within the Member States of the EU.

Article 27 1.

(iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;

In the case of deliveries of spent fuel elements out of Germany, a licence will only be granted provided the consignee, according to the documents available, fulfils the provisions outlined under Article 27 1. (iii), i.e. the international and/or European provisions are met and there are no substantiated doubts that this is so. In the case of deliveries of radioactive waste out of Germany, the requirements outlined in Article 27 1. (iii) are met by the consultation process pursuant to the AtAV in conjunction with Directive 92/3/EURATOM [EUR 92] (in this respect, cf. the comments on Article 27 1. (i) and (ii)).

Article 27 1.

(v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.

In accordance with Section 3 of the Atomic Energy Act (AtG), the re-import of spent fuel elements into Germany is possible in principle; the provisions in this respect were explained under Article 27 (1) i.

Generally speaking, a shipment of radioactive waste under the AtAV in conjunction with Directive 92/3/EURATOM facilitates the option of return shipment in case the envisaged delivery cannot be completed.

According to Section 7, Paragraph 1, No. 3 of the AtAV, shipment to another EU Member State will only be licensed provided measures are taken to ensure that the radioactive waste will be taken back by the original owner if delivery cannot be completed or the provisions for its shipment cannot be met.

According to Section 8, Paragraph 1, No. 4 of the AtAV, shipment to a third country will likewise only be licensed provided measures are taken to ensure that the radioactive waste will be taken back by the original owner if delivery cannot be completed or the provisions for its shipment cannot be met.

According to Section 9, Paragraph 1, No. 3 of the AtAV, shipment from a third country into Germany will only be licensed provided the domestic consignee of the radioactive waste has reached a binding agreement with the foreign owner of the radioactive waste, with the consent of the competent authority in the third country, that the foreign owner will take back the radioactive waste if the shipment process cannot be completed.

Finally, according to Section 13, Paragraph 1, No. 2 of the AtAV, the BAFA may only give its approval to a shipment from another EU Member State to Germany provided measures have been taken to ensure that the radioactive waste will be taken back by the original owner if delivery cannot be completed or the provisions for its shipment cannot be met.

Article 27

2. A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.

In Germany, shipments to the aforementioned region for the purpose of storage or disposal will not be licensed. Germany ratified the Antarctic Treaty of 1 December 1959 [ANT 78] on 22 December 1978. Article V of this Treaty includes a ban on the shipment of radioactive waste south of latitude 60 degrees South. The Treaty was incorporated into national law and entered into force on 5 February 1979, thereby obligating Germany to comply with this ban. Section 5 of the AtAV likewise prohibits shipments into this region.

Article 27

3. Nothing in this Convention prejudices or affects:

Article 27 3.

(i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

With respect to the freedom of international maritime traffic, Germany has legally committed itself to observe the requirements of this Article insofar as it has acceded to the United Nations Convention on the Law of the Sea of 10 December 1982. It was transformed into national law by the Act on the United Nations Convention on the Law of the Sea of 10 December 1982 [UNCLOS 94].

With regard to the freedom of river navigation, it should be noted that Germany is a Party to the Revised Convention on Navigation on the Rhine (*Revidierte Rheinschifffahrtsakte*) of 17 October 1868 [Rhein 68] and to the Convention of 27 October 1956 on the Canalization of the Moselle [Mosel 57].

With respect to air traffic, the requirements of this Article are met by Germany's accession to the International Agreement on the Transit of Air Services (*Vereinbarung über den Durchflug im internationalen Linienverkehr*) [Linien 56]. This Agreement stipulates that the Member States shall reciprocally grant one other the rights of the so-called first and second freedoms of air traffic, i. e. the right to pass over and to land for technical reasons. These commitments have been transformed into national law by the Act of Approval *(Zustimmungsgesetz*) on the basis of Article 59, para. 2 of Germany's Basic Law (*Grundgesetz*, GG).

Article 27 3.

(ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;

The right referred to in this Article is not impaired by the incorporation of the Convention into German legislation. German legislation does not include an obligation to accept the return of waste; it is instead agreed contractually with these export procedures.

Article 27 3.

(iii) the right of a Contracting Party to export its spent fuel for reprocessing;

This right remains unaffected until 30 June 2005. Thereafter, the shipment of German spent fuel elements for reprocessing will no longer be admissible, not because of the incorporation of this Convention into German legislation, but by virtue of the Amendment to the German Atomic Energy Act of 22 April 2002.

Article 27 3.

(iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

The right referred to in this Article is not impaired by including the Convention in German legislation. On the contrary: in an exchange of notes with the French government of April 1990 and with the British government of September 1991, the German government has reinforced the rights of both these nations to return the waste and other products arising from the reprocessing of spent German fuel elements to Germany.

Section J. Disused Sealed Sources

Article 28 (Disused sealed sources)

Article 28

1. *Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.*

National law

Sealed radioactive materials are defined in Section 3, para. 2, no. 29 of the Radiation Protection Ordinance (StrlSchV) [1A-8] as radioactive substances which are permanently covered on all sides by an airtight, solid, inactive cover or which are permanently embedded in solid inactive materials in such a way that any escape of radioactivity from handling under normal working conditions is reliably prevented. Furthermore, Section 23, para. 2 of the Atomic Energy Act (AtG) [1A-3] defines large sources as radioactive material whose level of activity per package to be carried or shipped exceeds 1000 TBq. Sealed sources are used in materials testing, in large irradiation facilities, in various other segments of industry, as well as in research and medicine.

In Germany, those parts of the EURATOM Basic Safety Standards [1F-18] pertaining to radioactive sources are translated into national legislation by the StrlSchV. In addition, the relevant results in this respect of the Code of Conduct on the Safety and Security of Radioactive Sources [IAEA 01] adopted by the General Assembly of the IAEA in September 2000 and the Technical Document on the Categorisation of Radiation Sources [IAEA 00] have likewise been taken into account. Furthermore, Germany welcomes the endeavours of the European Commission to create regulations for this field, particularly the proposed Council Directive on the Control Of High Activity Sealed Radioactive Sources [EUR 02].

The following parts of German legislation on radiation protection are relevant with respect to radioactive sources:

The handling of radiation sources (as well as of radioactive substances in general) requires a licence in accordance with Section 7 of the StrlSchV. Very small sources not exceeding the exemption levels as laid down in Appendix III, Table 1, columns 2 or 3 of the StrlSchV (Section 8, para. 1 in conjunction with Appendix 1, part B, no. 1 or 2 of the StrlSchV) are exempt from this requirement, as is the use of type-tested devices which may contain radiation sources (Section 8, para. 1 in conjunction with Appendix 1, part B, no. 4 of the StrlSchV).

Note: The provisional ruling outlined in Section 117, paragraph 7 of the StrlSchV referring to type approvals issued prior to 1 August 2001 is also relevant in this context. Such type approvals will remain valid until the deadlines specified in the approval certificate. In such cases, the relevant parts of the StrlSchV of 30 June 1989 shall apply, including those relating to licence-free handling in Section 4, paragraphs 1 and 2 (each in conjunction with Appendix II, nos. 2 or 3 and Appendix II, part B, no. 4). The record-keeping obligations for type-approved devices falling under this regulation are regulated in Section 78, paragraph 1, no. 1 of the StrlSchV of 30 June 1989, which stipulates that its whereabouts must be notified to the competent authority.

Sections 69, 70 and 71 of the StrlSchV regulate the acquisition and disposal of radiation sources. For example, Section 69, para. 1 of the StrlSchV contains the basic requirement that radioactive substances whose handling is subject to a licence under Section 7 of the StrlSchV and other pertinent regulations may only be handed over to persons who are in the possession of the necessary licence. According to Section 69, para. 2 of the StrlSchV, when sealed radioactive substances are handed over to another user for further use, the assignee must be provided with a certificate verifying that the casing is tight and contamination-free. Section 69, paragraphs 3 and 4 of the StrlSchV regulate transport and transfer to the consignee. Administrative fines for offences against the regulations of Section 69 of the StrlSchV are laid down in Section 116 of the StrlSchV. Liability with respect to large sources is regulated in Section 38, para. 4, no. 4 and Section 40, para. 2, no. 3 of the AtG.

According to Section 70, para. 1 of the StrlSchV, the competent authority must be notified within one month of any extraction, production, acquisition, disposal and whereabouts of radioactive material and therefore also of radioactive sources, including details of type and activity, and records must be kept. Section 70, para. 4 of the StrlSchV requires that the certificate of tightness of sealed radioactive materials referred to above must also include notification regarding acquisition of the radiation source. Type-approved radiation sources which may be used without a licence in accordance with Section 8, paragraph 1 in conjunction with Appendix 1, part B, no. 4 of the Radiation Protection Ordinance (StrlSchV) must be returned immediately to the holder of the approval upon completion of use in accordance with Section 27, paragraph 1, no. 5 of the StrlSchV.

Section 71 of the StrlSchV regulates the loss, discovery and acquisition of actual control over radioactive materials. Any loss of actual control over radioactive materials whose activity exceeds the exemption levels stipulated in Appendix III, table 1, columns 2 and 3 of the StrlSchV (this includes radiation sources) must be reported immediately to the competent nuclear supervisory authority or to the authority responsible for public safety and order by the owner of the material. Likewise, any discovery and acquisition of actual control over such materials must also be reported immediately to the competent nuclear supervisory authority or to the authority responsible for public safety and order.

The requirements relating to the technical qualification of persons who handle radioactive sources are laid down in the Guideline on Technical Qualification in the Field of Radiation Protection [3-40]. The requirements are grouped according to the qualifications necessary for different types of work.

Despite this comprehensive regulatory framework, it is impossible to rule out altogether the possibility of rare cases of radioactive sources being lost and found. Such events are documented in the annual reports of the Federal Office for Radiation Protection (BfS) [BfS 02]. In this way, the general public is kept informed about and sensitised to these types of issues.

Measures for the safe handling of sources

Sealed radiation sources may be particularly hazardous, partly because they are small and used in mobile equipment. As the radioactive substances are encapsulated in metal, outsiders and persons who deal with metal waste could easily come into contact with them. The radiological relevance of disused radiation sources which are not properly disposed of and which may find their way into scrap or onto landfill sites have been recognised by numerous industrialised countries, specifically those with a significant metal processing industry, including Germany. Following the announcement of findings in the Eighties of a number of radiation sources with Co-60 and Cs-137, some of which having very high activities (up to a magnitude of TBq), metal-processing plants and scrap dealers equipped themselves with monitors to enable them to detect any concealed radiation sources in incoming trucks, rail or ship consignments. In Germany, virtually all large scrap-handling locations, metal-processing plants, and increasingly landfill sites and conventional waste treatment facilities as well, are now equipped with such monitors.

In addition to the installation of monitors, which is based on the initiative of private industry, monitoring facilities have also been created at various border crossings in Germany in order to detect as early as possible and prevent the import of radiation sources and other forms of contamination. It has been found that the procedures in the individual *Länder* (Federal States) for the creation of such facilities and in the event of detection of disused radiation sources have not yet been harmonised in full.

In Germany, there have been a number of reports over the years of findings of lost or illegally disposed of disused radiation sources in scrap. In recent years, this trend has shown a decrease, since efforts to prevent the input of such sources amongst scrap-issuing companies have evidently borne fruit. This has been assisted by the rigorous application of private law agreements between scrap suppliers and scrap purchasers, under which the presence of activity levels in excess of background levels constitutes a defect and entitles the purchaser to cancellation.

In Germany, there have been a number of in-depth investigations into the radiological consequences of radioactivity in scrap, particularly of lost disused radiation sources, but also of NORM residues or contamination with nuclides of anthropogenic origin. In this context, a gradual procedure has been developed for handling an activity alarm, depending on the dose level of the respective scrap consignment. Under this procedure, material may be further processed provided it falls below the lower threshold limit of 0.1 µSv/h; if the upper threshold limit of 5 µSv/h is exceeded, the competent authority must always be consulted, and the load must be secured. For the range between these two limits, an approach must be decided in collaboration with the competent authority. Many metal-processing plants, landfill sites and thermal waste treatment facilities now follow this recommendation.

In addition to these reactive measures upon discovering a radiation source, preventive measures to prevent the loss of disused radiation sources are also highly significant. As outlined in the comments on Article 28 1. and 2., to this end, German radiation protection legislation envisages an extensive set of regulations. However, the fact that a certain number of lost radiation sources, generally of minimum source strength, are still discovered each year indicates that the system of monitoring in this respect is still in need of improvement.

Article 28

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

Disused sealed sources may only be returned to Germany as regular radioactive material provided the consignee is the original manufacturer who must meet the provisions outlined (as stipulated in Section 5, Paragraph 2, sentence 4 of the Radioactive Waste Shipment Ordinance (AtAV) [1A-18]), or provided the consignee verifiably subjects it to licensed use for irradiation purposes.

According to Section 20, paragraph 1 of the Radiation Protection Ordinance (StrlSchV), such sources may only be shipped from a third country to Germany without a licence under Section 19, paragraph 1 of the same ordinance provided the importing deliverer

1. has taken precautions to ensure that after shipment, the delivered radioactive materials may only initially be bought by persons who hold the necessary licence according to Sections 6, 7 or 9 of the AtG or according to Section 7, paragraph 1 or Section 11, paragraph 2 of the StrlSchV, and

2. reports the shipment to the competent authority as stipulated in Section 22, paragraph 2 of the StrlSchV or another office designated by it in connection with customs processing at the latest, using a form stipulated by it.

In the case of shipment of such radioactive material between EU Member States, the provisions of Regulation (EURATOM) 1493/93 [EUR 93] apply. This stipulates the following with regard to sealed sources:

(Article 4)

(1) A holder of sealed sources who intends to carry out a shipment of such sources, or to arrange for such a shipment to be carried out, shall obtain a prior written declaration by the consignee of the radioactive substances to the effect that the consignee has complied, in the Member State of destination, with all applicable provisions implementing Directive 96/29/EURATOM [1F-18] and with national requirements for safe storage, usage or disposal of that class or source of waste.

The declaration shall be made by means of the standard documents set out in Annex I to this Regulation (i.e. Regulation (EURATOM) No. 1493/93).

(2) The declaration referred to in paragraph 1 shall be sent by the consignee to the competent authority of the Member State to which the shipment is to be made. The competent authority shall confirm with its stamp on the document that it has taken note of the declaration and the declaration shall then be sent by the consignee to the holder.

However, this is merely a statement of intent which does not permit any control over shipments that have actually taken place, since the Regulation furthermore stipulates:

(Article 5)

(1) The declaration referred to in Article 4 may refer to more than one shipment, provided that:

- the sealed sources or radioactive waste to which it relates have essentially the same physical and chemical properties,
- the sealed sources or radioactive waste to which it relates do not exceed the levels of activity set out in the declaration and
- the shipments are to be made from the same holder to the same consignee and involve the same competent authorities.

(2) The declaration shall be valid for a period of not more than three years from the date of stamping by the competent authority as referred to in Article 4 (2).

A reporting system for realized shipments of radioactive materials is outlined below:

(Article 6)

A holder of sealed sources, other relevant sources and radioactive waste who has carried out a shipment of such sources or waste, or arranged for such a shipment to be carried out, shall, within 21 days of the end of each calendar quarter, provide the competent authorities in the Member State of destination with the following information in respect of deliveries during the quarter:

- names and addresses of consignees;
- the total activity per radionuclide delivered to each consignee and the number of such deliveries made;
- the highest single quantity of each radionuclide delivered to each consignee

– the type of substance: sealed source, other relevant source or radioactive waste.

As a result of this reporting procedure, it is evident that the competent authorities in each EU Member State (in Germany the BAFA) only receive data about shipments into their country on a quarterly basis, the completeness of which cannot otherwise be verified. There is no provision under this Regulation for reports regarding shipments from one country to another EU Member State. In order to rectify this loophole, Germany has submitted a proposal to the EU Commission outlining the need to report to the authority of the delivering country as well.

Section K. Planned Activities to Improve Safety

By the time the ban on transportation to reprocessing facilities enters into force on 1 July 2005 at the latest, all required decentralised interim storage facilities at the sites of nuclear power plants should be operational, thereby avoiding the need for the transportation of nuclear material within Germany.

Once the “Committee on a Site Selection Procedure for Repository Sites” has completed its work, the Federal Government will submit to the *Bundestag* (Lower House of Parliament) a proposed resolution regarding the criteria and site selection procedure for repositories in accordance with the 1998 coalition agreement. On the issue of financing the exploration works, the Federal Government is hoping to reach an agreement with the power supply companies which reflects their responsibilities as polluters. Issues of responsibility and procedure, including decision-making on repository sites, will be regulated by law.

The Federal Government is currently in the process of drafting a “national waste management plan” outlining the current status, subsequent procedure and timetable for waste management until to disposal.

The Federal Government supports the European Commission’s initiative to establish uniform minimum standards for the safe operation of nuclear power plants and other nuclear facilities in an extended European Union. The latter also incorporates those facilities falling under the scope of this Convention. However, the Federal Government feels that the content of the draft document to establish common standards in the area of the safety of nuclear installations is missing the objective.

Following the final shutdown of the Mülheim-Kärlich nuclear power plant in 2002, from which all fuel elements have since been removed, the Stade nuclear power plant will leave the grid in 2003 and will undergo decommissioning.

Section L. Annexes

(a) List of Spent Fuel Management Facilities

The following Tables list the facilities for spent fuel management:

- Wet storage facilities for spent fuel assemblies and their inventories (Table L–1),
- External dry storage facilities for spent fuel assemblies (Table L–2),
- Pilot conditioning plant at Gorleben (Table L–3)
- Interim storage facilities for spent fuel assemblies for which licences have been submitted under Section 6 of the Atomic Energy Act (AtG) (Table L–4)

Table L–1: Wet storage facilities for spent and partially spent fuel assemblies and their inventories
(Reference date: 31 December 2001)

Reactor, site	Licensed positions	Number of positions available for storage [4]	Of which not yet occupied	Stored quantity [3] [t HM]
Cooling ponds at the reactor:				
Brunsbüttel	828	296	71	38
Krümmel	1690	850	4	143
Brokdorf	768	575	63	254
Stade	322	176	29	52
Unterweser	615	422	97	158
Grohnde	768	575	79	264
Emsland	768	575	49	281
Biblis A	582	388	39	173
Biblis B	578	385	0	203
Obrigheim [1]	1210	1113	930	53
Philippsburg 1	948	356	37	54
Philippsburg 2	897	704	59	282
Neckarwestheim 1	310	133	1	45
Neckarwestheim 2	786	593	13	260
Gundremmingen B	3219	2435	557	287
Gundremmingen C	3219	2435	829	263
Isar 1	2232	1640	798	139
Isar 2	792	599	113	240
Grafenrheinfeld	715	522	81	223
Other cooling ponds:				
ZAB Greifswald [2]	4680	4680	1675	347

[1] including extension outside the reactor building
[2] only for fuel assemblies from Rheinsberg and Greifswald
[3] spent and partially spent fuel assemblies
[4] taking into account the positions that must be kept free for unloading of the core

Table L–2: External dry storage facilities for spent fuel assemblies (Reference date: 31 December 2001)

Site	Types of containers	Licensed quantities	Already stored
Ahaus	CASTOR® Ia, Ib, Ic, IIa, V/19, V/19, Series 06 onwards and V/52 at a total of 370 fuel element positions CASTOR® THTR/AVR at a total of 320 storage positions (50 fuel element positions) Applied for: CASTOR® MTR 2	3960 t HM $2x10^{20}$ Bq	3 CASTOR® V/52 (27 t HM) 3 CASTOR® V/19 (31 t HM) 305 CASTOR® THTR/AVR containers (50 fuel element positions in total)
Gorleben	CASTOR® Ia, Ib, Ic, IIa, V/19, V/52, TN 900/1-21 and CASTOR® HAW 20/28 CG, HAW 20/28, Series No. 16 onwards, and TS 28V at a total of 420 fuel element positions	3800 t HM $2x10^{20}$ Bq	1 CASTOR® IIa (5 t HM) 1 CASTOR® Ic (3 t HM) 3 CASTOR® V/19 (31 t HM) 15 CASTOR® HAW 20/28 CG with 420 glass logs
Greifswald (ZLN)	CASTOR® 440/84 at 80 fuel element positions	585 t HM $7.5x10^{18}$ Bq	4 CASTOR® 440/84 from Rheinsberg (29 t HM) 16 CASTOR® 440/84 from Greifswald (155 t HM)
Jülich	CASTOR® THTR/AVR (max. 158 containers)	225 kg nuclear fuel; no activity limit	approx. 241000 AVR fuel element spheres in 129 CASTOR® THTR/AVR containers

Table L–3: Pilot conditioning plant (PKA), Gorleben

Site	Purpose	Capacity	Status
Gorleben	Originally: Conditioning of spent fuel assemblies from power and research reactors; reloading of HLW glass logs into packages suitable for disposal According to stipulation of 11 June 2001: Use restricted to the repair of defect containers	35 t HM/a	Constructed, but not yet operational. Licensed by 3rd Partial License (TEG) of 18/19 December 2000. Immediate execution has not been applied for.

Table L–4: Main characteristics of the interim spent fuel storage facilities applied for under Section 6 of the Atomic Energy Act (AtG)
(Reference date: 30 September 2002)

Nuclear power plant, *Land* (Federal State)	**Applicant Date of application**	**Description**	**Mass HM [t]**	**Activity [Bq]**	**Thermal power [MW]**	**Sto-rage posi-tions**	**Period of use [years]**	**Type Dimensions L x W x H wall/roof [m]**	**Container**	**Remarks**
Biblis (KWB) Hesse	RWE Power AG 23 December 1999	Fuel element storage facility Biblis	1400	8.5×10^{19}	6.3	135	40	WTI concept 92x38x18 0.85/0.55	CASTOR® V/19	
	RWE Power AG 30 November 2000	Temporary storage facility at the Biblis site	300	7.6×10^{18}	0.7	28	5 (8 years had been applied for)	Storage area: 7.50 x 4.00 x 3.75; wall and roof element: 0.40	CASTOR® V/19	Licensed on 20/12/01
Brokdorf (KBR) Schleswig-Holst.	E.ON Kernkraft GmbH 20 December 1999	Interim storage facility at the Brokdorf site	1000	8×10^{19}	3.75	100	40	STEAG concept 93x27x23 1.20/1.30	CASTOR® V/19	
Brunsbüttel (KKB) Schleswig-Holst.	Kernkraftwerk Brunsbüttel GmbH 30 November 1999	Onsite storage facility Brunsbüttel	300	4×10^{19}	1.2	80	40	STEAG concept 88x27x23 1.20/1.30	CASTOR® V/52	
	Kernkraftwerk Brunsbüttel GmbH 15 August 2000	Temporary storage facility Brunsbüttel	140	1.6×10^{19}	0.67	18	6	Storage area: 7.5 x 4.00 x 3.75; wall and roof element: 0.40	CASTOR® V/52	
Grafenrheinfeld (KKG) Bavaria	E.ON Kernkraft GmbH 23 February 2000	Storage facility for fuel element containers Grafenrheinfeld	800	5×10^{19}	3.9	88	40	WTI concept 62x38x18 0.85/0.55	CASTOR® V/19	
Grohnde (KWG) Lower Saxony	E.ON Kernkraft GmbH 20 December 1999	Interim storage facility at the Grohnde site	1000	8×10^{19}	3.75	100	40	STEAG concept 93x27x23 1.20/1.30	CASTOR® V/19	

Nuclear power plant, *Land* (Federal State)	Applicant Date of application	Description	Mass HM [t]	Activity [Bq]	Thermal power [MW]	Storage positions	Period of use [years]	Type Dimensions L x W x H wall/roof [m]	Container	Remarks
Gundremmingen (KRB) Bavaria	RWE Energie AG (now: RWE Power AG) 25 February 000	Interim fuel element storage facility at the NPP Gundremmingen site	2250	2.7×10^{20}	7.4	192	40	WTI concept 104x38x18 0.85/0.55	CASTOR® V/52	
Isar (KKI) Bavaria	E.ON Kernkraft GmbH 23 February 2000	Storage facility for fuel element containers Isar	1500	1.5×10^{20}	6.4	152	40 (Utilisation period of the storage facility: 80 a)	WTI concept 92x38x18 0.85/0.55	CASTOR® V/52 CASTOR® V/19	
Krümmel (KKK) Schleswig-Holstein	Kernkraftwerk Krümmel GmbH 30 November 1999	Onsite interim storage facility Krümmel	800	1.2×10^{20}	3.2	80	40	STEAG concept 83x27x23 1.20/1.30	CASTOR® V/52	
	Kernkraftwerk Krümmel GmbH 15 August 2000	Temporary storage facility Krümmel	120	1.5×10^{19}	0.48	12	6	Storage area: 7.50 x 4.00 x 3.75; wall and roof element: 0.40	CASTOR® V/52	
Emsland (KKE) Lower Saxony	Kernkraftwerke Lippe-Ems GmbH 22 December 1998	Onsite interim storage facility Lingen	1250	1×10^{20}	5	130	40	STEAG concept 110x30x20 1.20/1.30	CASTOR® V/19	
Neckarwestheim (GKN) Baden-Wuerttem-berg	Gemeinschaftskernkraft werk Neckar GmbH 20 December 1999	Interim storage facility at the site of the Neckar community nuclear power plant	1600	1×10^{20}	3.5	151	40	2 tunnel tubes 112 and 82 x 12.8 x 17.3 respectively	CASTOR® V/19	Tunnel tube system
	Gemeinschaftskernkraft werk Neckar GmbH 20 December 1999 Specification: 22 May 2000	Onsite temporary storage facility	250	1.5×10^{19}	.,78	24	5 (8 years had been applied for)	Storage area: 7.50 x 4.00 x 3.75; wall and roof element: 0.30 / 0.40	CASTOR® V/19	Licensed on 10 April 2002

Nuclear power plant, *Land* (Federal State)	Applicant Date of application	Description	Mass HM [t]	Activity [Bq]	Thermal power [MW]	Storage positions	Period of use [years]	Type Dimensions L x W x H wall/roof [m]	Container	Remarks
Philippsburg (KKP) Baden-Wuerttemberg	EnBW Kraftwerke AG 20 December 1999	Interim storage facility at the site of the NPP Philippsburg	1600	$1.5x10^{20}$	6.4	152	40	WTI concept 92x37x18 0.70/0.55	CASTOR® V/19 CASTOR® V/52	
	EnBW Kraftwerke AG 20 December 1999	Temporary storage facility at the site of the NPP Philippsburg	260	$3x10^{19}$	0.84	24	5 (8 years had been applied for)	Storage area: 7.50 x 4.00 x 3.75; wall and roof element: 0.40	CASTOR® V/19 CASTOR® V/52	Licensed on 31 July 2001
Unterweser (KKU) Lower Saxony	E.ON Kernkraft GmbH 20 December 1999	Interim storage facility at the Unterweser site	800	$6.4x10^{19}$	3.0	80	40	STEAG concept 80x27x23 1.20/1.30	CASTOR® V/19	

Note: For the temporary storage facilities already licensed at the Biblis, Philippsburg and Neckarwestheim sites, some of the licensed values differ from the application values (e.g. period of use, mass, activity, thermal power).

(b) List of Radioactive Waste Management Facilities

The following Tables list the radioactive waste management facilities.

- Facilities for the conditioning of radioactive waste (Table L–5),
- Interim storage facilities for radioactive waste – external interim storage facilities (Table L–6),
- Interim storage facilities for radioactive waste – interim storage facilities in research institutions (Table L–7),
- Interim storage facilities for radioactive waste – interim storage facilities of the nuclear industry (Table L–8),
- Interim storage facilities for radioactive waste – State collecting facilities (Table L–9)
- Repositories for radioactive waste and planned repositories (projects) in the Federal Republic of Germany (Table L–10).

Table L–5 Facilities for the conditioning of radioactive waste

Facility name	Operator	Facility description	Facility site
PETRA drying facility	GNS Gesellschaft für Nuklear-Service mbH, Essen Forschungszentrum Jülich (FZJ) Energiewerke Nord, Lubmin	Drying of high-pressure compressed waste in 200-l drums, 280-l drums or 400-l drums	Mobile use in nuclear facilities and stationary use at the GNS Duisburg site; Stationary facility in the decontamination plant of the FZJ Stationary facility in the Zwischenlager Nord (ZLN)
Drying facility	AEA Technology QSA GmbH (AEAT), Braunschweig	Drying of drums up to defined residual humidity,	Stationary facility at AEAT
PETRA IV drying facility	Service centre of the FRAMATOME ANP company, Karlstein	Drying of solid and liquid waste, currently in test operation	Stationary facility in the Service centre of FRAMATOME ANP Karlstein
FAVORIT mobile drying facility	GNS Gesellschaft für Nuklear-Service mbH	Drying of liquid waste in 200-l drums, 400-l drums and in MOSAIK cast-iron containers	Mobile use in nuclear installations
Drying facility for mixed waste and sludges	Hansa Projekt Anlagentechnik GmbH, Hamburg	Drum or small container dryer in variable design for 180-l collapsible drums, 200-l or 400-l drums, small containers	Mobile or stationary use in nuclear installations
Mobile facility for the refilling and dehydration of nodular resins	Hansa Projekt Anlagentechnik GmbH, Hamburg	Dehydration of nodular resins in pressed cartridges, 200-l drums or cast-iron containers	Mobile use in nuclear installations
Drying facility for drums	Verein für Kernverfahrenstechnik und Analytik Rossendorf e. V. (VKTA)	2-drum drying facility for the drying of sludges, ion-exchange resins, humid soil Drying time: 10-14 days Volume reduction: max. 60 %	Stationary facility at VKTA
Resin drying facility	Verein für Kernverfahrenstechnik und Analytik Rossendorf e. V. (VKTA)	Drying of max. 240 l of spent ion-exchange resin. Volume reduction approx. 50 %	Stationary facility at VKTA

Facility name	Operator	Facility description	Facility site
FAKIR high-pressure hydraulic press	GNS Gesellschaft für Nuklear-Service mbH Forschungszentrum Jülich Energiewerke Nord, Lubmin	Compacting loose waste with the aid of metal cartridges Waste volume reduction up to Factor 10	Mobile use in nuclear installations and stationary use at GNS Duisburg site; Stationary facility in the FZJ decontamination facility Stationary facility at the ZLN
SUPERPACK Mobile high-pressure press 2000 t	Hansa Projekt Anlagentechnik GmbH (HPA), Hamburg	Processing of 180-l, 200-l or 220-l drums Capacity: max. 20 drums/h	Mobile use in nuclear installations
Compacting facility	Forschungszentrum Karlsruhe (FZK)	Low-level radioactive waste Caisson technology with gas protection clothing, max. throughput 3000 m^3/a Volume reduction factor 6; Medium-level radioactive waste Remote handling technology with air-lock and work cells, manipulators, hydraulic shears, hydraulic press	Stationary facility at the decontamination division (HDB) of FZK Stationary facility at the decontamination division (HDB) of FZK
Compacting facility	Service centre of FRAMATOME ANP, Karlstein	Pressing of 180-l cartridge drums Capacity: 8-10 drums/h	Stationary facility at the service centre of FRAMATOME ANP Karlstein
Compacting facility	AEA Technology QSA GmbH (AEAT), Braunschweig	Compaction of 200-l drums and of collapsible drums, pressure $\geq$ 30 MPa Capacity : 5000 – 10000 pressing operations / a	Stationary facility at AEAT
In-drum press	Verein für Kernverfahrenstechnik und Analytik Rossendorf e. V. (VKTA)	30-l to 40-l bags are pressed directly into waste drums.	Stationary facility at VKTA
Combustion facilities	Forschungszentrum Jülich GmbH, Forschungszentrum Karlsruhe	Combustion of solid and liquid waste	Stationary facility at the decontamination facility of FZJ Stationary facility at the decontamination division (HDB) of FZK
Dismantling/decontamination cabin REBEKA	Forschungszentrum Jülich GmbH,	Decontamination in 2 steel cabins of parts weighing up to 25 t by mechanical means with subsequent dismantling	Stationary facility at the decontamination facility of FZJ

Facility name	Operator	Facility description	Facility site
Karlsruhe vitrification plant	Forschungszentrum Karlsruhe	Vitrification of approx. 70 m^3 high-level radioactive fission product concentrate from the operation of the WAK; currently under construction; commissioning planned for 2003	Karlsruhe reprocessing plant at FZK
Evaporation and immobilisation facility	Forschungszentrum Karlsruhe	Evaporation of low-level radioactive waste water with subsequent cementation of the residues. Max. throughput 6000 m^3/a Volume reduction factor 100	Stationary facility at the HDB of the FZK
Decontamination cell	AEA Technology QSA GmbH (AEAT), Braunschweig	Decontamination of equipment parts (e. g. sandblasting), crushing of equipment parts (e. g. flexing, sawing) Max. weight 1 t/piece	Stationary facility at AEAT
Decontamination facility	Service-Zentrum der Fa. FRAMATOME ANP, Karlstein	Wet and dry decontamination processes in stationary and mobile devices, installations and handling cabins	Stationary facility at the Service Centre of FRAMATOME ANP Karlstein
Cementing facility	AEA Technology QSA GmbH (AEAT), Braunschweig	Immobilisation of waste water with fixing materials, immobilisation of ion-exchange resins with fixing materials	Stationary facility at AEAT
Dismantling facility with decontamination	Service-Zentrum der Fa. FRAMATOME ANP, Karlstein	Comprehensive mechanical and thermal separation and dismantling equipment	Stationary facility at the Service Centre of FRAMATOME ANP Karlstein
Decontamination tubs for chemical decontamination	Energiewerke Nord, Lubmin	Capacity of first tub 2 x 2.5 m^3 Capacity of second tub 5 m^3	Stationary facility at the ZAW
Evaporation facility	Energiewerke Nord, Lubmin	Processing of radioactive liquid waste Throughput 1 m^3/h	Stationary facility at Zwischenlager Nord (ZLN)
Rotary thin-film evaporation facility RDVA	Energiewerke Nord, Lubmin	Processing of radioactive liquid waste Throughput 200-250 l/h Reservoir 7 m^3	Stationary facility in the KGR, special building of units 3 & 4, Lubmin

Facility name	Operator	Facility description	Facility site
Evaporation facility	Forschungszentrum Jülich GmbH,	Processing of low-level radioactive waste water, concentrates and sludges; total volume 825 m³, delivery in tankers	Stationary facility at the decontamination facility of the FZJ
Conditioning facility for concentrates (tandem conditioning facility)	Hansa Projekt Anlagentechnik GmbH, Hamburg	Loading capacity: 1 x 200-l drum Evaporation: 3-4l/h Drying temperature.: 150-250 °C	Mobile or stationary use in nuclear installations
Metal cutting facility MARS	GNS Gesellschaft für Nuklear-Service mbH	Compression (pressing) and subsequent cutting up of metal parts that can be melted afterwards	Stationary use at the GNS Duisburg site
Metal cutting facility MARS	Energiewerke Nord, Lubmin	Compression (pressing) and subsequent cutting up of metal parts that can be melted afterwards	Stationary facility at ZLN
Band-saw	Energiewerke Nord, Lubmin	Cutting up of solid waste	Stationary facility at ZLN Stationary facility at ZAW
Vertical longitudinal cut band-saw	Energiewerke Nord, Lubmin	Cutting up of solid waste	Stationary facility at ZAW
Hydraulic shears	Energiewerke Nord, Lubmin	Cutting up of solid waste of C and stainless steels (round bars, square bars)	Stationary facility at ZAW
Cable stripping machine	Energiewerke Nord, Lubmin	Removal of insulation from cable diameter range: Ø 1.5 mm to 90 mm	Stationary facility at ZAW
Plasma cutting facility	Energiewerke Nord, Lubmin	Dismantling of austenitic steels Max. cutting range	Stationary facility at ZAW
Thermal dismantling room	Energiewerke Nord, Lubmin	With air extraction and filter device, 1 t bridge crane,	Stationary facility at ZAW
High-pressure wet blast facility with working cabin	Energiewerke Nord, Lubmin	Working cabin with air extraction and filter system Dismantling/cutting by means of automatic device Decontamination by means of hand-held lance	Stationary facility at ZAW

Facility name	Operator	Facility description	Facility site
Mobile dry blast facility	Energiewerke Nord, Lubmin	Blasting room 8 m² Height 2.5 m Blasting material steel grit or garnet sand	Mobile facility at ZAW
Dismantling installations	Verein für Kernverfahrenstechnik und Analytik Rossendorf e. V. (VKTA)	Plasma cutting facility up to 20 mm Cold and band-saws up to 350 mm Ø Hydraulic shears	Stationary facility at VKTA
Dismantling box for aerosol filters	Verein für Kernverfahrenstechnik und Analytik Rossendorf e. V. (VKTA)	In the dismantling box, aerosol filters are dismantled until the parts can be placed in a docked 200-l drum.	Stationary facility at VKTA
Cementing facility	Siemens AG	Conditioning of waste from the operation and dismantling of Siemens fuel fabrication plants	Stationary facility in Hanau
High-pressure press	Siemens AG	Conditioning of waste from the operation and dismantling of Siemens fuel fabrication plants	Stationary facility in Hanau
Ion exchange facility	Verein für Kernverfahrenstechnik und Analytik Rossendorf e.V. (VKTA)	Treatment of radioactive waste water, plant throughput 2 m³/h	Stationary facility at VKTA

Table L–6: Interim storage facilities for radioactive waste – External interim storage facilities

Name of facility and site	Purpose of the facility	Capacity acc. to licence	Licence	Remarks
ABFALLLAGER GORLEBEN (FASSLAGER) Lower Saxony	Storage of radioactive waste from nuclear power plants, medicine, research and trade	200-l, 400-l drums, type III concrete containers, type I-II cast-iron containers, type I-IV containers with a total activity of up to $5x10^{18}$ Bq	Handling licences according to Section 3 of the StrlSchV *) of 27 October 1983, 13 October 1987 and 13 September 1995	In operation since October 1984
ABFALLLAGER ESENSHAMM Lower Saxony	Storage of low-level radioactive waste from the nuclear power plants Unterweser and Stade	200-l and 400-l drums, concrete containers, sheet-steel containers, cast-iron containers with a total activity of up to $1.85x10^{15}$ Bq	Handling licences according to Section 3 of the StrlSchV*) of 24 June 1981, 29 November 1991 and 6 November 1998	In operation since autumn 1981
SAMMELSTELLE DER EVU MITTERTEICH Bavaria	Interim storage of waste with negligible heat generation from Bavarian nuclear facilities	40000 waste packages (200-l, 400-l or cast-iron containers)	Handling licences according to Section 3 of the StrlSchV*) of 7 July 1982	In operation since July 1987
ZWISCHENLAGER NORD (ZLN) Rubenow/Greifswald Mecklenburg-West Pomerania	Interim storage of operational and decommissioning waste from the nuclear power plants Greifswald and Rheinsberg, including interim storage of dismantled large components	200000 m^3	Handling licences according to Section 3 of the StrlSchV*) of 20 February 1998	In operation since March 1998

*) As amended on 13 October 1976 and 30 June 1989, respectively

Table L–7: Interim storage facilities for radioactive waste – Interim storage facilities in research institutions

Name of facility and site	Purpose of the facility	Capacity according to licence	Licence	Remarks
Forschungs- und Messreaktor Braunschweig (FMRB)	Operational waste from FMRB	Not determined in the licence	Section 7 of the AtG	Buffering of waste
Forschungsreaktor Garching	Operational waste from the research reactor	Not determined in the licence	Section 7 of the AtG	Approx. 100 m^3
Forschungszentrum Geesthacht	Operational waste from the research reactor	Not determined in the licence	Section 3 of the StrlSchV*)	Approx. 154 m^2 space for conditioned waste
Forschungszentrum Jülich	Waste with negligible heat generation, AVR fuel spheres, activated bulky waste	Not determined in the licence	Sections 6, 9 of the AtG, Section 3 of the StrlSchV*)	
Forschungszentrum Karlsruhe	1. Waste with negligible heat generation, 2. Heat-generating waste	1. 77424 m^3 (storage volume) 2. 1240 m^3 (storage volume)	Section 9 of the AtG	Incl. waste produced by some clients
Hahn-Meitner-Institut Berlin	Operational waste from the research centre	37 m^3	Section 7 of the AtG	
Institut für Radiochemie Garching	Operational waste from the research institution	Approx. 22 m^3	Section 9 of the AtG, Section 3 of the StrlSchV*)	
VKTA Rossendorf	Operational waste from the research site	2770 m^3 (gross total storage volume)	Section 3 of the StrlSchV*)	Rossendorf interim storage facility (ZLR)

*) as amended on 13 October 1976 and 30 June 1989, respectively

Table L–8: Interim storage facilities for radioactive waste – Interim storage facilities of the nuclear industry

Name of facility and site	Purpose of the facility	Capacity according to licence	Licence	Remarks
Advanced Nuclear Fuels GmbH (ANF), Lingen	Operational waste from fuel element fabrication	440 m^3	Sections 6, 7 of the AtG,	
NUKEM, Hanau	Waste with negligible heat generation, waste from dismantling	1500 m^3	Section 7 of the AtG	
Siemens, Hanau	Waste with negligible heat generation, waste from dismantling	5070 m^3	Sections 6, 7 of the AtG	Facility parts from MOX production and uranium processing
Siemens, Karlstein	Waste from dismantling	1580 m^3	Section 9 of the AtG Section 3 of the StrlSchV*)	
Zwischenlager der NCS, Hanau	Waste with negligible heat generation, operational waste and waste from dismantling produced by NUKEM, GNS etc.	1200 Konrad containers	Section 7 of the StrlSchV	Conditioned waste from the operation and dismantling of the Siemens fuel fabrication plant, Hanau
Urenco, Gronau	Operational waste from uranium enrichment	Approx. 40 m^3	Section 7 of the AtG	

*) as amended on 13 October 1976 and 30 June 1989, respectively

Table L–9: Interim storage facilities for radioactive waste – State collecting facilities

Name of facility and site	Purpose of the facility	Capacity according to licence	Licence	Remarks
State collecting facility Baden-Wuerttemberg, Karlsruhe	Waste from the medical field, research and industry	No capacity limit stated (capacity HDB: 78276 m³)	Section 9 of the AtG	State collecting facility at FZK in HDB, operator HDB
State collecting facility Bavaria, Mitterteich	Waste from the medical field, research and industry	10000 packages	Section 3 of the StrlSchV*)	
State collecting facility Berlin	Waste from the medical field, research and industry	400 m³	Section 3 of the StrlSchV*)	At the Hahn-Meitner-Institut
State collecting facility Hesse, Ebsdorfergrund	Waste from the medical field, research and industry	400 m³	Section 6 of the AtG, Section 3 of the StrlSchV*)	
State collecting facility Mecklenburg-Western Pomerania	Waste from the medical field, research and industry	Currently 1 container with 5.6 m³	Section 3 of the StrlSchV*)	State collecting facility at ZLN
State collecting facility Lower Saxony, Jülich	Waste from the medical field, research and industry	Capacity acc. to licence of approx. 300 200-l drums	Section 3 of theStrlSchV*)	In 2000, the State collecting facility in Steyerberg was closed, and this waste stored in the Leese storage facility of AEAT
State collecting facility Northrhine-Westphalia, Jülich	Waste from the medical field, research and industry	2430 m³	Section 3 of the StrlSchV*), Section 9 of the AtG	On the site of the *Forschungszentrum Jülich* (Jülich Research Centre)
State collecting facility Rhineland-Palatinate, Ellweiler	Waste from the medical field, research and industry	500 m³	Section 9 of the AtG, Section 3 of the StrlSchV*)	
State collecting facility Saarland, Elm-Derlen	Waste from the medical field, research and industry	50 m³	Section 3 of the StrlSchV*)	
State collecting facility Saxony, Rossendorf/Dresden	Waste from the medical field, research and industry	300 m³	Section 3 of the StrlSchV*)	At VKTA, also used by Thuringia
State collecting facility of the four north German coastal Federal State, Geesthacht	Waste from the medical field, research and industry	68 m³	Section 3 of theStrlSchV*)	Shared use by Schleswig-Holstein, Hamburg and Bremen
AEA Technology QSA GmbH, Leese	Waste from the medical field, research and industry	3240 m³	Section 3 of the StrlSchV*)	Waste from the State collecting facility in Steyerberg (Lower Saxony),

*) in the versions dated 13 October 1976 and 30 June 1989, respectively

Table L–10: Repositories for radioactive waste and planned repositories (projects) in the Federal Republic of Germany

Name of facility and location	Purpose of the facility	Amounts/activity disposed of	Licence	Remarks
FORSCHUNGSBERG-WERK ASSE Remlingen, Lower Saxony	Research and development work for the disposal of radioactive and radiotoxic waste Not a repository acc. to the definition of Section 9a of the AtG	Between 1967 and 1978 approx. 124500 LAW and approx. 1300 MAW waste packages were emplaced for trial purposes	Licence according to Section 3 of the StrlSchV in the version dated 15 October 1965	Geological host formation: rock salt
BERGWERK ZUR ERKUNDUNG DES SALZSTOCKS GORLEBEN Gorleben, Lower Saxony	Proof of the site's suitability for the disposal of all types of radioactive waste	Federal State	Application according to Section 9b of the AtG in 1977 (plan-approval application)	Geological host formation: rock salt Exploration of the site has been put on hold since 1 October 2000 whilst conceptual and safety-related issues are clarified.
ENDLAGER SCHACHT KONRAD Salzgitter, Lower Saxony	Repository for radioactive waste with negligible heat generation		Application according to Section 9b of the AtG in 1982 (plan-approval application) Official approval of the plan (licence) was granted in May 2002 but is not yet enforceable.	Geological host formation: coral oolite (iron ore) Beneath a water-impermeable barrier from the cretaceous period Commissioning: once the plan approval becomes legally valid after the on-going court proceedings are concluded and following a conversion phase of 4 years.
ENDLAGER FÜR RADIOAKTIVE ABFÄLLE MORSLEBEN (ERAM) Saxony-Anhalt	Disposal of low-level and medium-level radioactive waste with mainly short-lived radionuclides	Disposal of 36753 m^3 low-level and medium-level radioactive waste in total, total activity of all radioactive waste emplaced in the order of magnitude of 10^{14} Bq, activity of alpha-emitters in the order of magnitude of 10^{11} Bq.	22 April 1986: Permanent operating licence granted. 12 April 2001: A statement is made to the effect that no further radioactive waste will be accepted for disposal	Geological host formation: rock salt On 28 September 1998 emplacement operations were discontinued. Decommissioning has been applied for.

(c) List of Nuclear Facilities in the Process of Being Decommissioned

The following tables list those nuclear facilities which are currently in the process of decommissioning, divided into the following categories:

- Nuclear power plants including prototype reactors with electrical power generation (Table L–11),
- Research reactors with a thermal power of 1 MW or above (Table L–12),
- Research reactors with a thermal power of less than 1 MW (Table L–13),
- Commercial fuel cycle facilities (Table L–14).
- Research and prototype fuel cycle facilities (Table L–15)

In each table the facilities are listed in alphabetical order.

Table L–11: Nuclear power plants including prototype reactors with electrical power generation

	Name of facility, location	Last operator	Type of facility, electrical output (gross)	First criticality	Final shut-down	Status	Planned final status
1	VAK Versuchsatomkraftwerk, Kahl, Bavaria	Versuchsatomkraft werk Kahl GmbH	BWR 16 MWe	11/1960	11/1985	Dismant-ling	Removal, clearance of the site
2	MZFR Mehrzweckforschungs-reaktor, Karlsruhe, Baden-Württemberg	Forschungs-zentrum Karlsruhe GmbH	PWR with D_2O 57 MWe	09/1965	05/1984	Dismant-ling	Removal, clearance of the site
3	KKR Rheinsberg Rheinsberg, Brandenburg	Energiewerke Nord GmbH	PWR (WWER) 70 MWe	03/1966	06/1990	Dismant-ling	Clearance of the site
4	KRB A Gundremmingen A, Gundremmingen, Bavaria	Kernkraftwerk RWE-Bayernwerk GmbH	BWR 250 MWe	08/1966	01/1977	Dismant-ling	Not yet decided
5	AVR Atomversuchskraftwerk, Jülich, North Rhine-Westphalia	Arbeitsgemein-schaft Versuchsreaktor GmbH	HTGR 15 MWe	08/1966	12/1988	Prepa-ration of safe contain-ment	Removal, clearance of the site
6	KWL Lingen, Lingen, Lower Saxony	Kernkraftwerk Lingen GmbH	BWR 252 MWe	01/1968	01/1977	Safe contain-ment	Not yet decided
7	HDR Heißdampfreaktor, Großwelzheim, Bavaria	Forschungs-zentrum Karlsruhe GmbH	BWR 25 MWe	10/1969	04/1971	Removed	-
8	KWW Würgassen, Würgassen, North Rhine-Westphalia	E.ON Kernkraft	BWR 670 MWe	10/1971	08/1994	Dis-mantling	Clearance of the site
9	KKN Niederaichbach Niederaichbach, Bavaria	Forschungs-zentrum Karlsruhe GmbH	HWGCR 106 MWe	12/1972	07/1974	Removed	-
10	KGR 1 Greifswald 1 Lubmin, Mecklenburg-Western Pomerania	Energiewerke Nord GmbH	PWR (WWER) 440 MWe	12/1973	12/1990	Dis-mantling	Clearance of the site
11	KGR 2 Greifswald 2 Lubmin, Mecklenburg-Western Pomerania	Energiewerke Nord GmbH	PWR (WWER) 440 MWe	12/1974	02/1990	Dis-mantling	Clearance of the site
12	KGR 3 Greifswald 3 Lubmin, Mecklenburg-Western Pomerania	Energiewerke Nord GmbH	PWR (WWER) 440 MWe	10/1977	02/1990	Dis-mantling	Clearance of the site

	Name of facility, location	Last operator	Type of facility, electrical output (gross)	First criticality	Final shut-down	Status	Planned final status
13	KNK II Kompakte Natriumgekühlte Reaktoranlage, Karlsruhe, Baden-Württemberg	Forschungs-zentrum Karlsruhe GmbH	FBR 21 MWe	10/1977	08/1991	Dis-mantling	Removal, clearance of the site
14	KGR 4 Greifswald 4 Lubmin, Mecklenburg-Western Pomerania	Energiewerke Nord GmbH	PWR (WWER) 440 MWe	07/1979	06/1990	Dis-mantling	Clearance of the site
15	THTR-300 Thorium-Hochtemperaturreaktor, Hamm-Uentrop, North Rhine-Westphalia	Hochtemperatur-Kernkraft GmbH	HTGR 308 MWe	09/1983	09/1988	Safe contain-ment	Not yet decided
16	KMK Mülheim-Kärlich Mülheim-Kärlich, Rhineland-Palatinate	RWE Power AG	PWR 1302 MWe	03/1986	09/1988	Decomm. applied for	Clearance of the site
17	KGR 5 Greifswald 5 Lubmin, Mecklenburg-Western Pomerania	Energiewerke Nord GmbH	PWR (WWER) 440 MWe	03/1989	11/1989	Dis-mantling	Clearance of the site

Table L–12: Research reactors with a thermal power of 1 MW or above that have been removed or are in the decommissioning phase

	Name of facility, location	Last operator	Type, thermal. output	First criticality	Final shut-down	Status	Planned final status
1	FMRB – Braunschweig, Lower Saxony	Physikalisch-Technische Bundesanstalt	Pool 1 MW	10/1967	12/1995	Dis-mantling	Removal
2	FR-2 – Karlsruhe, Baden-Württemberg	Forschungs-zentrum Karlsruhe GmbH	Tank 44 MW	03/1961	12/1981	Reactor in safe contain-ment	Removal
3	FRG-2 – Geesthacht, Schleswig-Holstein	GKSS Forschungs-zentrum Geesthacht GmbH	Pool 15 MW	03/1963	01/1993	Shut down	Removal
4	FRJ-1 MERLIN – Jülich, North Rhine-Westphalia	Forschungs-zentrum Jülich GmbH	Pool 10 MW	02/1962	03/1985	Dis-mantling	Removal
5	FRN – Neuherberg, Bavaria	GSF Forschungs-zentrum für Umwelt u. Gesundheit GmbH	TRIGA 1 MW	08/1972	12/1982	Safe contain-ment	Not yet decided
6	Nuklearschiff Otto Hahn, Geesthacht, Schleswig-Holstein	GKSS Forschungs-zentrum Geesthacht GmbH	PWR, ship's engine 38 MW	08/1968	03/1979	Ship's reactor dismantled	Removal
7	RFR – Rossendorf, Saxony	VKTA Rossendorf	Tank, WWR 10 MW	12/1957	06/1991	Dis-mantling	Not yet decided

Table L–13: Research reactors with a thermal power of less than 1 MW that have been removed or are in the decommissioning phase

	Name of facility, location	Last operator	Type, thermal output	First criticality	Final shut-down	Status	Planned final status
1	ADIBKA – Jülich, North Rhine-Westphalia	Forschungs-zentrum Jülich GmbH	Homog. reactor 0.1 kW	03/1967	10/1972	Removed	-
2	AEG Nullenerige-Reaktor – Karlstein, Bavaria	Kraftwerk Union	Tank 0.1 kW	06/1967	01/1973	Removed	-
3	ANEX – Geesthacht, Schleswig-Holstein	GKSS Forschungs-zentrum Geesthacht GmbH	Critical formation, 0.1 kW	05/1964	02/1975	Removed	-
4	BER-I – Berlin	Hahn-Meitner-Institut Berlin	Homog. reactor 50 kW	07/1958	12/1972	Reactor filled in concrete	Not yet decided
5	FRF-1 – Frankfurt/M.	Johann-Wolfgang-Goethe-Universität Frankfurt/M.	Homog. reactor 10 kW	01/1958	03/1968	Dis-mantling	Removal
6	FRH – Hannover, Lower Saxony	Medizinische Hochschule Hannover	TRIGA 250 kW	01/1973	01/1997	Dis-mantling	Not yet decided
7	HD I – Heidelberg, Baden-Württemberg	Deutsches Krebsforschungs-zentrum Heidelberg	TRIGA 250 kW	08/1966	03/1977	Partially removed, safe contain-ment	Removal, clearance of the site
8	HD II – Heidelberg, Baden-Württemberg	Deutsches Krebsforschungs-zentrum Heidelberg	TRIGA 250 kW	02/1978	11/1999	Appl. for decommis-sioning licence under prepa-ration	Removal, clearance of the site
9	KAHTER, Jülich, North Rhine-Westphalia	Forschungs-zentrum Jülich GmbH	Critical formation, 0.1 kW	07/1973	02/1984	Removed	-
10	KEITER, Jülich, North Rhine-Westphalia	Forschungs-zentrum Jülich GmbH	Critical formation, 1 W	06/1971	01/1982	Removed	-
11	PR-10, AEG Prüfreaktor, Karlstein, Bavaria	Kraftwerk Union	Argonaut 0.18 kW	01/1961	1976	Removed	-
12	RAKE, Rossendorf, Saxony	VKTA Rossendorf	Tank 0.01 kW	10/1969	11/1991	Removed	-
13	RRR, Rossendorf, Saxony	VKTA Rossendorf	Argonaut 1 kW	12/1962	07/1991	Removed	-

	Name of facility, location	Last operator	Type, thermal output	First criticality	Final shut-down	Status	Planned final status
14	SAR, Munich, Bavaria	Technische Universität München	Argonaut 1 kW	06/1959	10/1968	Removed	-
15	SNEAK, Karlsruhe, Baden-Württemberg	Forschungs-zentrum Karlsruhe GmbH	Homog. reactor 1 kW	12/1966	11/1985	Removed	-
16	STARK, Karlsruhe, Baden-Württemberg	Forschungs-zentrum Karlsruhe GmbH	Argonaut 0.01 kW	01/1963	03/1976	Removed	-
17	SUR Bremen – Bremen	Hochschule Bremen	Homog. reactor < 1 W	10/1967	06/1993	Removed	-
18	SUR Darmstadt – Darmstadt, Hesse	Technische Hochschule Darmstadt	Homog. reaktor < 1 W	09/1963	02/1985	Removed	-
19	SUR Hamburg – Hamburg	Fachhochschule Hamburg	Homog. reactor < 1 W	01/1965	01/1997	Removed	-
20	SUR Karlsruhe – Karlsruhe, Baden-Württemberg	Forschungs-zentrum Karlsruhe GmbH	Homog. reactor < 1 W	03/1966	09/1996	Removed	-
21	SUR München – Munich, Bavaria	Technische Universität München	Homog. Reactor < 1 W	02/1962	08/1981	Removed	-
22	SUAK – Karlsruhe, Baden-Württemberg	Forschungs-zentrum Karlsruhe GmbH	Fast subcrit. formation, < 1 W			Removed	-
23	SUA – Munich, Bavaria	Technische Universität München	Subcrit. formation, < 1 W			Removed	-

Table L–14: Commercial fuel cycle facilities that have been removed or are in the decommissioning phase

	Name of facility, location	Operator	Start of operation	End of operation	Status	Planned final status
1	HOBEG Brennelementwerk– Hanau, Hesse	Hobeg GmbH	1962	1988	Removed	-
2	NUKEM-A Brennelementwerk– Hanau, Hesse	Nukem GmbH	1962	1988	Dis-mantling	Removal
3	Siemens Brennelementwerk Betriebsteil Uran, Hanau, Hesse	Siemens AG	1969	1995	Dis-mantling	Removal
4	Siemens Brennelementwerk Betriebsteil MOX, Hanau, Hesse	Siemens AG	1968	1991	Dis-mantling	Removal
5	Siemens Brennelementwerk Betriebsteil Karlstein – Karlstein, Bavaria	Siemens AG	1966	1993	Continued conven-tional use	-
6	WAK Wiederaufarbeitungsanlage Karlsruhe, Karlsruhe, Baden-Württemberg	WAK Betriebsgesellschaft mbH	1971	1990	Dis-mantling	Removal

Table L–15: Research and prototype facilities that are in the process of decommissioning or have been removed with relevance for the nuclear fuel cycle

	Name of facility, location	Operator	Begin of operation	Final shut-down	Status	Planned final status
1	JUPITER Testanlage Wiederaufarbeitung – Jülich, North Rhine-Westphalia	Forschungszentrum Jülich GmbH	1976	1987	Removed	-
2	MILLI Laborextraktionsanlage – Karlsruhe, Baden-Württemberg	Forschungszentrum Karlsruhe GmbH	1970	1989	Removed	-
3	PUTE Plutoniumextraktionsanlage – Karlsruhe, Baden-Württemberg	Forschungszentrum Karlsruhe GmbH	1980	1991	Removed	-

(f) References to National Laws, Regulations, Requirements, Guides, etc

These references are listed according to the structure and sequence outlined in the "Reactor Safety and Radiation Protection Handbook". As a general rule, they must be taken into account during licensing and supervisory procedures by the regulatory body.

1 Regulations

1A National nuclear and radiation protection regulations

1B Regulations concerning the safety of nuclear installations

1C Regulations for the transport of radioactive material and accompanying regulations

1D Bilateral agreements in the nuclear field and in the area of radiation protection

1E Multilateral agreements on nuclear safety and radiation protection with national implementing regulations

1F Law of the European Union

2 General Administrative Regulations

3 Announcements by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the formerly competent ministry, the Federal Ministry for the Interior

4 Recommendations of the RSK

5 Rules of the Nuclear Safety Standards Commission (KTA)

1 Regulations

1A National Nuclear and Radiation Protection Regulations

[1A-1]	Gesetz zur Ergänzung des Grundgesetzes vom 23. Dezember 1959, betreffend §§ 74a Nr. 11, 87c (BGBl. I, S. 813)	
[1A-2]	Gesetz zur geordneten Beendigung der Kernenergienutzung zur gewerblichen Erzeugung von Elektrizität vom 22. April 2002 (BGBl. I S. 1351)	p. 8, 12
[1A-3]	Gesetz über die friedliche Verwendung der Kernenergie und den Schutz gegen ihre Gefahren (Atomgesetz - AtG) vom 23. Dezember 1959, Neufassung vom 15. Juli 1985 (BGBl. I, Nr. 41), zuletzt geändert durch Gesetz vom 19. Juli 2002 (BGBl. I, S. 2674, 2679)	various citations

[1A-4]	Fortgeltendes Recht der Deutschen Demokratischen Republik aufgrund von Artikel 9 Abs. 2 in Verbindung mit Anlage II Kapitel XII Abschnitt III Nr. 2 und 3 des Einigungsvertrages vom 31. August 1990 in Verbindung mit Artikel 1 des Gesetzes zum Einigungsvertrag vom 23. September 1990 (BGBl. II, S. 885, 1226), soweit dabei radioaktive Stoffe, insbesondere Radonfolgeprodukte, anwesend sind: • Verordnung über die Gewährleistung von Atomsicherheit und Strahlenschutz vom 11. Oktober 1984 und • Durchführungsbestimmung zur Verordnung über die Gewährleistung von Atomsicherheit und Strahlenschutz vom 11. Oktober 1984 (GBl.(DDR) I 1984, Nr. 30, berichtigt GBl.(DDR) I 1987, Nr. 18) • Anordnung zur Gewährleistung des Strahlenschutzes bei Halden und industriellen Absetzanlagen und bei Verwendung darin abgelagerter Materialien vom 17. November 1990 (GBl.(DDR) I 1990, Nr. 34)	p. 38, 39, 45
[1A-5]	Gesetz zum vorsorgenden Schutz der Bevölkerung gegen Strahlenbelastung (Strahlenschutzvorsorgegesetz - StrVG) vom 19. Dezember 1986 (BGBl. I, S. 2610), zuletzt geändert durch das Gesundheitseinrichtungen-Neuordnungsgesetz vom 24. Juni 1994 (BGBl. I 1994, Nr. 39)	p. 45, 79, 82, 84
[1A-8]	Verordnung über den Schutz vor Schäden durch ionisierende Strahlen (Strahlen-schutzverordnung - StrlSchV) vom 13. Oktober 1976, Neufassung vom 30. Juni 1989 (BGBl. I, S. 1321), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr. 38)	various citations
[1A-10]	Verordnung über das Verfahren bei der Genehmigung von Anlagen nach § 7 des Atomgesetzes (Atomrechtliche Verfahrensverordnung - AtVfV) vom 18. Februar 1977, Neufassung vom 3. Februar 1995 (BGBl. I 1995, Nr. 8), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr.38)	p. 45, 51, 53, 85, 96, 102, 116, 125
[1A-11]	Verordnung über die Deckungsvorsorge nach dem Atomgesetz (Atomrechtliche Deckungsvorsorge-Verordnung - AtDeckV) vom 25. Januar 1977 (BGBl. I 1977, S. 220), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr. 38)	p. 45, 51, 92
[1A-12]	Kostenverordnung zum Atomgesetz (AtKostV) vom 17. Dezember 1981 (BGBl. I, S. 1457), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr. 38)	
[1A-13]	Verordnung über Vorausleistungen für die Einrichtung von Anlagen des Bundes zur Sicherstellung und zur Endlagerung radioaktiver Abfälle (Endlagervorausleistungsverordnung - EndlagerVlV) vom 28. April 1982 (BGBl. I, S. 562), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr. 38)	p. 45, 95
[1A-17]	Verordnung über den kerntechnischen Sicherheitsbeauftragten und über die Meldungen von Störfällen und sonstigen Ereignissen (Atomrechtliche Sicherheitsbeauftragten- und Meldeverordnung - AtSMV) vom 14. Oktober 1992 (BGBl. I 1992, Nr. 48), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr. 38)	p. 46, 58, 64, 108
[1A-18]	Verordnung über die Verbringung radioaktiver Abfälle in das oder aus dem Bundesgebiet (Atomrechtliche Abfallverbringungsverordnung - AtAV) vom 27. Juli 1998 (BGBl. I 1998, Nr. 47), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr. 38)	p. 45, 136, 143

[1A-19]	Verordnung für die Überprüfung der Zuverlässigkeit zum Schutz gegen Entwendung oder erhebliche Freisetzung radioaktiver Stoffe nach dem Atomgesetz (Atomrechtliche Zuverlässigkeitsüberprüfungs-Verordnung - AtZüV) vom 1. Juli 1999 (BGBl. I 1999, Nr. 35), zuletzt geändert durch Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001 (BGBl. I 2001, Nr. 38)	p. 102, 123

1B Regulations Concerning the Safety of Nuclear Installations

[1B-1]	Strafgesetzbuch vom 15. Mai 1871 (RGBl. S. 127) in der Fassung der Bekanntmachung vom 10. März 1987 (BGBl. I 1987, S. 945+1160), zuletzt geändert (Kernenergie betreffend) durch Gesetz vom 26. Januar 1998 (BGBl. I 1998, Nr. 6)	p. 58
[1B-2]	Bau- und Raumordnungsgesetz 1998 vom 18. August 1997 (BGBl. I 1997, Nr. 59)	p. 48
[1B-3]	Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetz - BImSchG) in der Fassung der Bekanntmachung vom 14. Mai 1990 (BGBl. I 1990, S. 880), zuletzt geändert durch Gesetz vom 27. Dezember 2000 (BGBl. I 2000, Nr. 61), mit diversen Verordnungen	p. 48
[1B-5]	Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz) vom 27. Juli 1957, Neufassung vom 12. November 1996 (BGBl. I 1996, Nr. 58), zuletzt geändert durch Gesetz vom 27. Dezember 2000 (BGBl. I 2000, Nr. 61)	p. 48
[1B-6]	Gesetz über Naturschutz und Landschaftspflege (Bundesnaturschutzgesetz) vom 12. März 1987 (BGBl. I 1987, S. 889)	p. 48
[1B-7]	Gesetz über technische Arbeitsmittel (Gerätesicherheitsgesetz) vom 24. Juni 1968, Neufassung vom 23. Oktober 1992, (BGBl. I 1992, Nr. 49) zuletzt geändert durch Gesetz vom 27. Dezember 2000 (BGBl. I 2000, Nr. 61)	
1B-8]	Verordnung über Dampfkesselanlagen (Dampfkesselverordnung) vom 27. Februar 1980 (BGBl. I 1980, S. 173), zuletzt geändert am 22. Juni 1995 (BGBl. I 1995, S. 836)	
[1B-9]	Verordnung über Druckbehälter, Druckgasbehälter und Füllanlagen (Druckbehälter-Verordnung) in der Neufassung vom 21. April 1989 (BGBl. I 1989, S. 843), zuletzt geändert durch Verordnung vom 23. Juni 1999 (BGBl. I 1999, Nr. 33)	
[1B-10]	Unfallverhütungsvorschrift Kernkraftwerke (VBG 30) und Durchführungsanweisung zur Unfallverhütungsvorschrift vom 1. Januar 1987	
[1B-11]	Gesetz über den Verkehr mit Lebensmitteln, Tabakerzeugnissen, kosmetischen Mitteln und sonstigen Bedarfsgegenständen (Lebensmittel- und Bedarfsgegenständegesetz) vom 15. August 1974 (BGBl. I 1975, S. 2652), Neufassung vom 9. September 1997 (BGBl. I 1997, Nr. 63), mit diversen Verordnungen	
[1B-12]	Gesetz über Betriebsärzte, Sicherheitsingenieure und andere Fachkräfte für Arbeitssicherheit vom 12. Dezember 1973 (BGBl. I 1973, S. 1885), zuletzt geändert durch Gesetz vom 7. August 1996 (BGBl. I 1996, Nr. 43)	
[1B-13]	Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Beseitigung von Abfällen (Kreislaufwirtschafts- und Abfallgesetz) i. d. F. vom 27. September 1994 (BGBl. I S. 2705), zuletzt geändert durch Artikel 57 des Gesetzes vom 29. Oktober 2001 (BGBl. I S. 2785, 2797)	p. 48, 93

[1B-14]	Gesetz über die Umweltverträglichkeitsprüfung vom 12. Februar 1990, neugefasst durch Bek. v. 05.09.2001 I 2350; zuletzt geändert durch Art. 3 Abs. 9 G v. 25.03.2002 I 1193	p. 48, 50, 53, 96, 101, 115, 122
[1B-15]	Bundesberggesetz i. d. F. vom 13. August 1980 (BGBl. I S. 1310), zuletzt geändert durch Artikel 3 des Gesetzes vom 25. März 2002 (BGBl. I S. 1193, 1217)	p. 48, 131
[1B-16]	Gesetz über die Beförderung gefährlicher Güter (Gefahrgutbeförderungsgesetz - GGBefG) in der Fassung der Bekanntmachung vom 29. September 1998 (BGBl. 2001 I S. 3114)	
[1B-17]	Verordnung über die innerstaatliche und grenzüberschreitende Beförderung gefährlicher Güter auf der Straße und mit Eisenbahnen (Gefahrgutverordnung Straße und Eisenbahn - GGVSE) vom 11. Dezember 2001 (BGBl. 2001 I S. 3529)	
[1B-18]	Verordnung über die Beförderung gefährlicher Güter mit Seeschiffen (Gefahrgutverordnung See – GGVSee) vom 4. März 1998 (BGBl. I S. 419; 1999 S. 1435; 2001 S. 2785-2870, S. 2878)	
[1B-19]	Luftverkehrsgesetz (LuftVG) in der Fassung der Bekanntmachung vom 27. März 1999 (BGBl. 2001 I S. 550)	

1C Regulations for the Transport of Radioactive Material and Accompanying Regulations

1D Bilateral Agreements in the Nuclear Field and in the Area of Radiation Protection

[1D-1]	Abkommen zwischen der Bundesrepublik Deutschland und der Bundesrepublik Österreich über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 23. Dezember 1988	p. 84
[1D-2]	Abkommen zwischen der Bundesrepublik Deutschland und dem Königreich Belgien über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 6. November 1980	p. 84
[1D-3]	Abkommen zwischen der Bundesrepublik Deutschland und der Schweizerischen Eidgenossenschaft über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 28. November 1984	p. 84
[1D-4]	Abkommen zwischen der Bundesrepublik Deutschland und dem Königreich Dänemark über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 16. Mai 1985	p. 84
[1D-5]	Abkommen zwischen der Bundesrepublik Deutschland und der Französischen Republik über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 3. Februar 1977	p. 84
[1D-6]	Abkommen zwischen der Bundesrepublik Deutschland und der Regierung der Republik Ungarn über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 9. Juni 1997	p. 84
[1D-7]	Abkommen zwischen der Bundesrepublik Deutschland und der Republik Litauen über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 15. März 1994	p. 84
[1D-8]	Abkommen zwischen der Bundesrepublik Deutschland und dem Großherzogtum Luxemburg über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 7. Juli 1981	p. 84

[1D-9]	Abkommen zwischen der Bundesrepublik Deutschland und dem Königreich der Niederlande über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 7. Juni 1988	p. 84
[1D-10]	Abkommen zwischen der Bundesrepublik Deutschland und der Republik Polen über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 10. April 1997	p. 84
[1D-11]	Abkommen zwischen der Bundesrepublik Deutschland und der Russischen Föderation über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 16. Dezember 1992	p. 84
[1D-12]	Vertrag zwischen der Bundesrepublik Deutschland und der Tschechischen Republik über die gegenseitige Hilfeleistung bei Katastrophen und Unglücksfällen vom 19. September 2000	p. 84

1E Multilateral Agreements on Nuclear Safety and Radiation Protection with National Implementing Regulations

Nuclear Safety and Radiation Protection

[1E-1] Convention on Environmental Inpact Assessment in a Transboundary Context (Espoo-Konvention) vom 25. Februar 1991, in Kraft
von Deutschland gezeichnet am 26. Februar 1991
30 Vertragsparteien (7/00)

[1E-2] Übereinkommen über den Zugang zu Informationen, die Öffentlichkeitsbeteiligung an Entscheidungsverfahren und den Zugang zu Gerichten in Umweltangelegenheiten (Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus-Konvention) vom 25. Juni 1998, noch nicht in Kraft
von Deutschland gezeichnet am 21. Dezember 1998
9 Vertragsparteien, 40 Signatarstaaten (9/00)

[1E-3] Übereinkommen Nr. 115 der Internationalen Arbeitsorganisation vom 22. Juni 1960 über den Schutz der Arbeitnehmer vor ionisierenden Strahlen (Convention Concerning the Protection of Workers against Ionising Radiations, entry into force 17 June 1962)
Gesetz hierzu vom 23. Juli 1973 (BGBl. II 1973, Nr. 37)
in Kraft für Deutschland seit 26. September 1974 (BGBl. II 1973, Nr. 63)

[1E-4] Ratsbeschluss der Organisation für Wirtschaftliche Zusammenarbeit und Entwicklung (OECD) vom 18. Dezember 1962 über die Annahme von Grundnormen für den Strahlenschutz (OECD-Grundnormen) (Radiation Protection Norms)
Gesetz hierzu vom 29. Juli 1964 (BGBl. II 1964, S. 857)
in Kraft für Deutschland seit 3. Mai 1965
Neufassung vom 25. April 1968 (BGBl. II 1970, Nr. 20)

[1E-5] Übereinkommen vom 26. Oktober 1979 über den physischen Schutz von Kernmaterial (Convention on the Physical Protection of Nuclear Material (INFCIRC/274 Rev.1), entry into force 8 February 1987)
Gesetz hierzu vom 24. April 1990 (BGBl. II 1990, S. 326), zuletzt geändert durch das Strafrechtsänderungsgesetz vom 27. Juni 1994 (BGBl. I 1994, Nr. 40)
in Kraft für Deutschland seit 6. Oktober 1991 (BGBl. II 1995, Nr. 11)
68 Vertragsparteien (10/00)

[1E-6] Übereinkommen über die frühzeitige Benachrichtigung bei nuklearen Unfällen vom 26. September 1986 und Übereinkommen über Hilfeleistung bei nuklearen Unfällen oder radiologischen Notfällen vom 26. September 1986, (Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (INFCIRC/336), Convention on Early Notification of a Nuclear Accident (INFCIRC/335), entry into force 27 October 1986, both)
Gesetz zu den beiden IAEA-Übereinkommen vom 16. Mai 1989 (BGBl. II 1989, Nr. 18)
in Kraft für Deutschland seit 15. Oktober 1989 (BGBl. II 1993, Nr. 34)
Benachrichtigungsabkommen: 86 Vertragsparteien (10/00)
Hilfeleistungsabkommen: 82 Vertragsparteien (10/00)

[1E-7] Übereinkommen über nukleare Sicherheit vom 20. September 1994 (Convention on Nuclear Safety (INFCIRC/449), entry into force 24 Oktober 1996)
Gesetz dazu vom 7. Januar 1997 (BGBl. II 1997, Nr. 2)
in Kraft für Deutschland seit 20. April 1997 (BGBl. II 1997, Nr. 14)
53 Vertragsparteien (1/00)

[1E-8] Gemeinsames Übereinkommen vom 5. September 1997 über die Sicherheit der Behandlung abgebrannter Brennelemente und über die Sicherheit der Behandlung radioaktiver Abfälle (Übereinkommen über nukleare Entsorgung) (Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, not yet in force)
Gesetz hierzu vom 13. August 1998 (BGBl. II 1998, Nr. 31)
23 Vertragsparteien (1/01)

[1E-9] Vertrag vom 1. Juli 1968 über die Nichtverbreitung von Kernwaffen, (Atomwaffensperrvertrag), (Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/140), entry into force 5 March 1970)
Gesetz dazu vom 4. Juni 1974 (BGBl. II 1974, S. 785)
in Kraft für Deutschland seit 2. Mai 1975 (BGBl. II 1976, S. 552)
Verlängerung des Vertrages auf unbegrenzte Zeit am 11. Mai 1995 (BGBl. II 1995, S. 984)
187 Vertragsparteien (6/99)

[1E-10] Übereinkommen vom 5. April 1973 zwischen dem Königreich Belgien, dem Königreich Dänemark, der Bundesrepublik Deutschland, Irland, der Italienischen Republik, dem Großherzogtum Luxemburg, dem Königreich der Niederlande, der Europäischen Atomgemeinschaft und der Internationalen Atomenergie-Organisation in Ausführung von Artikel III Absätze 1 und 4 des Vertrages vom 1. Juli 1968 über die Nichtverbreitung von Kernwaffen (Verifikationsabkommen), (INFCIRC/193), entry into force for all Parties 21 February 1977
Gesetz hierzu vom 4. Juni 1974 (BGBl. II 1974, S. 794)
Ausführungsgesetz hierzu vom 7. Januar 1980 (BGBl. I 1980, S. 17), zuletzt geändert durch Gesetz vom 27. Dezember 1993 (BGBl. I 1993, S. 2378)
Zusatzprotokoll vom 22. September 1998
Gesetz zum Zusatzprotokoll vom 22. September 1998 vom 29. Januar 2000 (BGBl. I 2000, Nr. 4)
Ausführungsgesetz zum Verifikationsabkommen und zum Zusatzprotokoll vom 29. Januar 2000 (BGBl. I 2000, Nr. 5)

Liability

[1E-11]	Übereinkommen vom 29. Juli 1960 über die Haftung gegenüber Dritten auf dem Gebiet der Kernenergie (Pariser Atomhaftungs-Übereinkommen) ergänzt durch das Protokoll vom 28. Januar 1964 (BGBl. II 1976, S. 310), (Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention), as amended, entry into force 1 April 1968) Gesetz hierzu vom 8. Juli 1975 (BGBl. II 1975, S. 957), geändert durch Gesetz vom 9. Juni 1980 (BGBl. II 1980, S. 721) in Kraft für Deutschland seit 30. September 1975 (BGBl. II 1976, S. 308) Bekanntmachung vom 15. Juli 1985 der Neufassung des Pariser Atomhaftungs-Übereinkommens mit Berücksichtigung der Änderungen durch das Protokoll vom 16. November 1982 (BGBl. II 1985, S. 963) in Kraft für Deutschland seit 7. Oktober 1988 (BGBl. II 1989, S. 144)	p. 51
[1E-12]	Zusatzübereinkommen vom 31. Januar 1963 zum Pariser Übereinkommen vom 29. Juli 1960 (Brüsseler Zusatzübereinkommen), ergänzt durch das Protokoll vom 28. Januar 1964 (BGBl. II 1976, S. 310), (Convention Supplementary to the Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy (Brussels Supplementary Convention), entry into force 4 December 1974) Gesetz hierzu vom 8. Juli 1975 (BGBl. II 1975, S. 957), geändert durch Gesetz vom 9. Juli 1980 (BGBl. II 1980, S. 721) in Kraft für Deutschland seit 1. Januar 1976 (BGBl. II 1976, S. 308) Bekanntmachung vom 15. Juli 1985 der Neufassung des Brüsseler Zusatzübereinkommens mit Berücksichtigung der Änderungen durch das Protokoll vom 16. November 1982 (BGBl. II 1985, S. 963) in Kraft für Deutschland seit 1. August 1991 (BGBl. II 1995, S. 657)	p. 51
[1E-13]	Protokolle vom 16. November 1982 zur Änderung des Pariser Atomhaftungs-Übereinkommens vom 29. Juli 1960 in der Fassung des Zusatzprotokolls vom 28. Januar 1964 und des Brüsseler Zusatzübereinkommens vom 31. Januar 1963 in der Fassung des Zusatzprotokolls vom 28. Januar 1964 Gesetz hierzu vom 21. Mai 1985 (BGBl. II 1985, S. 690)	
[1E-14]	Convention on Supplementary Compensation for Nuclear Damage of 12 September 1997, not yet in force 13 Signatarstaaten (6/99)	
[1E-15]	Abkommen zwischen der Bundesrepublik Deutschland und der Schweizerischen Eidgenossenschaft über die Haftung gegenüber Dritten auf dem Gebiet der Kernenergie vom 22. Oktober 1986 Gesetz dazu vom 28. Juni 1988 (BGBl. II 1988, S. 598) in Kraft für Deutschland seit 21. September 1988 (BGBl. II 1988, S. 955)	

1F Law of the European Union

Agreements, general

[1F-1]	Vertrag vom 25. März 1957 zur Gründung der Europäischen Atomgemeinschaft (**EURATOM**) in der Fassung des Vertrages über die **Europäische Union** vom 7. Februar 1992, geändert durch den Beitrittsvertrag vom 24. Juni 1994 in der Fassung des Beschlusses vom 1. Januar 1995 (BGBl. II 1957, S. 753, 1014, 1678; BGBl. II 1992, S. 1251, 1286; BGBl. II 1993, S. 1947; BGBl. II 1994, S. 2022; ABl. EG 1995, Nr. L1), der Vertrag ist in seiner ursprünglichen Fassung am 1. Januar 1958 in Kraft getreten (BGBl. 1958 II S. 1), die Neufassung trat am 1. November 1993 in Kraft (BGBl. 1993 II S. 1947), Berichtigung der Übersetzung des EURATOM-Vertrages vom 13. Oktober 1999 (BGBl. II 1999, Nr. 31)	p. 44, 99

[1F-2] Verifikationsabkommen siehe [1E-10]

[1F-3] Verordnung (EURATOM) 3227/76 der Kommission vom 19. Oktober 1976 zur Anwendung der Bestimmungen der EURATOM-Sicherungsmaßnahmen (ABl. EG 1976, Nr. L363), geändert durch Verordnung EURATOM 2130/93 der Kommission vom 27. Juli 1993 (ABl. EG 1993, Nr. L191)

[1F-4] Bekanntmachung über die Meldung an die Behörden der Mitgliedsstaaten auf dem Gebiet der Sicherungsmaßnahmen gemäß Artikel 79 Abs. 2 des EURATOM-Vertrages vom 12. August 1991 (BAnz. Nr. 158)

[1F-7] Agreement for Co-operation in the Peaceful Uses of Nuclear Energy between EURATOM and the United States of America, signed on March 29, 1996 (ABl. EG 1996, Nr. L120) in Kraft seit 12. April 1996
Hinweis: Laufzeit 30 Jahre, Nachfolgevereinbarung für ein entsprechendes Abkommen, das 35 Jahre in Kraft war, Basis für den Handel mit Nuklearmaterial und Ausrüstung

[1F-10] Empfehlung 2000/473/EURATOM der Kommission vom 8. Juni 2000 zur Anwendung des Artikels 36 des EURATOM-Vertrages zur Überwachung des Radioaktivitätsgehaltes der Umwelt zur Ermittlung der Exposition der Gesamtbevölkerung (ABl. EG 2000, Nr. L191)

[1F-11] Empfehlung 91/4/EURATOM der Kommission vom 6. Dezember 1999 betreffend die Anwendung von Artikel 37 des EURATOM-Vertrages (ABl. EG 1999, Nr. L324)

[1F-12] Richtlinie 85/337/EWG des Rates vom 27. Juni 1985 über die Umweltverträglichkeitsprüfung bei bestimmten öffentlichen und privaten Projekten (ABl. EG 1985, Nr. L??)
Gesetz hierzu ("Gesetz über die Umweltverträglichkeitsprüfung") vom 12. Februar 1990 (BGBl. I 1990, S. 205), zuletzt geändert durch das 6. Überleitungsgesetz vom 25. September 1990 (BGBl. I 1990, S. 2106)

[1F-13] Richtlinie 97/11/EG des Rates vom 3. März 1997 zur Änderung der Richtlinie 85/337/EWG über die Umweltverträglichkeitsprüfung bei bestimmten öffentlichen und privaten Projekten (ABl. EG 1997, Nr. L73) p. 102
"UVP-Änderungsrichtlinie", derzeit in der Umsetzung

[1F-14] Richtlinie 90/313/EWG des Rates vom 7. Juni 1990 über den freien Zugang zu Informationen über die Umwelt (ABl. EG 1990, Nr. L158)

- Gesetz hierzu ("Umweltinformationsgesetz - UIG") vom 8. Juli 1994 (BGBl. I 1994, Nr. 42)
- Verordnung über Gebühren für Amtshandlungen der Behörden des Bundes beim Vollzug des Umweltinformationsgesetzes (Umweltinformationsgebührenverordnung) vom 7. Dezember 1994 (BGBl. I 1994, Nr. 88)

[1F-15] Richtlinie 98/34/EG des Europäischen Parlaments und des Rates vom 22. Juni 1998 über ein Informationsverfahren auf dem Gebiet der Normen und technischen Vorschriften (ABl. EG 1998, Nr. L204)

[1F-16] Richtlinie 98/37/EG des Europäischen Parlaments und des Rates vom 22. Juni 1998 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten für Maschinen (ABl. EG 1998, Nr. L207)

Radiation Protection

[1F-17] Empfehlung 91/444/EURATOM der Kommission vom 26. Juli 1991 zur Anwendung von Artikel 33 des EURATOM-Vertrages (ABl. EG 1991, Nr. L238)

[1F-18]	Richtlinien des Rates, mit denen die Grundnormen für den Gesundheitsschutz der Bevölkerung und der Arbeitskräfte gegen die Gefahren ionisierender Strahlungen festgelegt wurden (EURATOM-Grundnormen) • Richtlinie vom 2. Februar 1959 (ABl. EG 1959, Nr. 11), • Richtlinie vom 5. März 1962 (ABl. EG 1962, S. 1633/62), • Richtlinie 66/45/EURATOM (ABl. EG 1966, Nr. 216), • Richtlinie 76/579/EURATOM vom 1. Juni 1976 (ABl. EG 1976, Nr. L187), • Richtlinie 79/343/EURATOM vom 27. März 1977 (ABl. EG 1979, Nr. L83), • Richtlinie 80/836/EURATOM vom 15. Juli 1980 (ABl. EG 1980, Nr. L246), • Richtlinie 84/467/EURATOM vom 3. September 1984 (ABl. EG 1984, Nr. L265), • Neufassung mit Berücksichtigung der ICRP 60 in Richtlinie 96/29/EURATOM vom 13. Mai 1996 (ABl EG 1996, Nr. L159)	p. 44, 71, 72, 77, 94, 141, 144
[1F-19]	Mitteilung der Kommission zur Durchführung der Richtlinien des Rates 80/836/EURATOM und 84/467/EURATOM (ABl. EG 1985, Nr. C347)	
[1F-20]	Richtlinie 90/641/EURATOM des Rates vom 4. Dezember 1990 über den Schutz externer Arbeitskräfte, die einer Gefährdung durch ionisierende Strahlung bei Einsatz im Kontrollbereich ausgesetzt sind (ABl. EG 1990, Nr. L349)	
[1F-21]	Richtlinie 94/33/EG des Rates vom 22. Juni 1994 über Jugendarbeitsschutz (ABl. EG 1994, Nr. L216)	

Radiological Emergencies

[1F-28]	Entscheidung 87/600/EURATOM des Rates vom 14. Dezember 1987 über Gemeinschaftsvereinbarungen für den beschleunigten Informationsaustausch im Fall einer radiologischen Notstandssituation (ABl. EG 1987, Nr. L371)	
[1F-29]	Richtlinie 89/618/EURATOM des Rates vom 27. November 1989 über die Unterrichtung der Bevölkerung über die bei einer radiologischen Notstandssituation geltenden Verhaltensmaßregeln und zu ergreifenden Gesundheitsschutzmaßnahmen (ABl. EG 1989, Nr. L357) • Mitteilung der Kommission betreffend die Durchführung der Richtlinie 89/618/EURATOM (ABl. EG 1991, Nr. C103)	p. 83
[1F-30]	Verordnungen zur Festlegung von Höchstwerten an Radioaktivität in Nahrungsmitteln und Futtermitteln im Fall eines nuklearen Unfalls oder einer anderen radiologischen Notstandssituation: • Ratsverordnung (EURATOM) 3954/87 vom 22. Dezember 1987; (ABl. EG 1987, Nr. L371) geändert durch Ratsverordnung (EURATOM) 2218/89 vom 18. Juli 1989 (ABl. EG 1989, Nr. L211), • Kommissionsverordnung (EURATOM) 944/89 vom 12. April 89 (ABl. EG 1989, Nr. L101), • Kommissionsverordnung (EURATOM) 770/90 vom 29. März 1990 (ABl. EG 1990, Nr. L83)	
[1F-31]	Ratsverordnung (EWG) 2219/89 vom 18. Juli 1989 über besondere Bedingungen für die Ausfuhr von Nahrungsmitteln und Futtermitteln im Falle eines nuklearen Unfalls oder einer anderen radiologischen Notstandssituation (ABl. EG 1989, Nr. L211)	

[1F-32]	Ratsverordnung (EWG) 3955/87 vom 22. Dezember 1987 über die Einfuhrbedingungen für landwirtschaftliche Erzeugnisse mit Ursprung in Drittländern nach dem Unfall im Kernkraftwerk Tschernobyl (ABl. EG 1987, Nr. L371), • Verordnung (EWG) 1983/88 der Kommission vom 5. Juli 1988 mit Durchführungsbestimmungen zu der Verordnung (EWG) 3955/87 (ABl. EG 1988, Nr. L174), • Verordnung (EWG) 4003/89 des Rates vom 21. Dezember 1989 zur Änderung der Verordnung (EWG) 3955/87 (ABl. EG 1989, Nr. L382), • Verordnung (EWG) 737/90 des Rates vom 22. März 1990 zur Ergänzung der Verordnung (EWG) 3955/87 (ABl. EG 1990, Nr. L82), • Verordnung (EG) 686/95 des Rates zur Verlängerung der Verordnung (EWG) 737/90 (ABl. EG 1995, Nr. L71), • Verordnungen der Kommission zur Festlegung einer Liste von Erzeugnissen die von der Durchführung der Verordnung (EWG) 737/90 des Rates über die Einfuhrbedingungen für landwirtschaftliche Erzeugnisse mit Ursprung in Drittländern nach dem Unfall im Kernkraftwerk Tschernobyl ausgenommen sind, • Verordnung (EWG) 146/91 vom 22. Januar 1991 (ABl. EG 1991, Nr. L17), • Verordnung (EWG) 598/92 vom 9. März 1992 (ABl. EG 1992, Nr. L64), • Verordnung (EWG) 1518/93 vom 21. Juni 1993 (ABl. EG 1993, Nr. L150), • Verordnung (EG) 3034/94 vom 13. Dezember 1994 (ABl. EG 1994, Nr. L321)	

2 General Administrative Provisions

[2-1]	Allgemeine Verwaltungsvorschrift zu § 45 Strahlenschutzverordnung: Ermittlung der Strahlenexposition durch die Ableitung radioaktiver Stoffe aus kerntechnischen Anlagen oder Einrichtungen vom 21. Februar 1990 (BAnz. 1990, Nr. 64a), in Überarbeitung – neuer Bezug auf § 47 StrlSchV i. d. F. v. 20. Juli 2001	p. 46, 76, 104, 125
[2-2]	Allgemeine Verwaltungsvorschrift zu § 62 Abs. 2 Strahlenschutzverordnung (AVV Strahlenpaß) vom 3. Mai 1990 (BAnz. 1990, Nr. 94a), in Überarbeitung	p. 46
[2-3]	Allgemeine Verwaltungsvorschrift zur Ausführung des Gesetzes über die Umweltverträglichkeitsprüfung (UVPVwV) vom 18. September 1995 (GMBl. 1995, Nr. 32)	p. 46
[2-4]	Allgemeine Verwaltungsvorschrift zum Integrierten Meß- und Informationssytem nach dem Strahlenschutzvorsorgegesetz (AVV-IMIS) vom 27. September 1995 (BAnz. 1995, Nr. 200a)	p. 46, 79

3 Announcements by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Federal Ministry for the Interior (Extract)

[3-1]	Sicherheitskriterien für Kernkraftwerke vom 21. Oktober 1977 (BAnz. 1977, Nr. 206)	p. 46, 90, 103
[3-2]	Richtlinie für den Fachkundenachweis von Kernkraftwerkspersonal vom 14. April 1993 (GMBl. 1993, Nr. 20)	
[3-4]	Richtlinien über die Anforderungen an Sicherheitsspezifikationen für Kernkraftwerke vom 27. April 1976 (GMBl. 1976, S. 199)	

[3-5]	Merkpostenaufstellung mit Gliederung für einen Standardsicherheitsbericht für Kernkraftwerke mit Druckwasserreaktor oder Siedewasserreaktor vom 26. Juli 1976 (GMBl. 1976, S. 418)	
[3-6]	Richtlinie für den Schutz von Kernkraftwerken gegen Druckwellen aus chemischen Reaktionen durch Auslegung der Kernkraftwerke hinsichtlich ihrer Festigkeit und induzierten Schwingungen sowie durch Sicherheitsabstände vom 13. September 1976 (BAnz. 1976, Nr. 179)	
[3-7-1]	Zusammenstellung der in atomrechtlichen Genehmigungs- und Aufsichtsverfahren für Kernkraftwerke zur Prüfung erforderlichen Informationen (ZPI) vom 20. Oktober 1982 (BAnz. 1983, Nr. 6a)	
[3-7-2]	Zusammenstellung der zur bauaufsichtlichen Prüfung kerntechnischer Anlagen erforderlichen Unterlagen vom 6. November 1981 (GMBl. 1981, S. 518)	
[3-8]	Grundsätze für die Vergabe von Unteraufträgen durch Sachverständige vom 29. Oktober 1981 (GMBl. 1981, S. 517)	
[3-9-1]	Grundsätze zur Dokumentation technischer Unterlagen durch Antragsteller/Genehmigungsinhaber bei Errichtung, Betrieb und Stillegung von Kernkraftwerken vom 19. Februar 1988 (BAnz. 1988, Nr. 56)	
[3-9-2]	Anforderungen an die Dokumentation bei Kernkraftwerken vom 5. August 1982 (GMBl. 1982, S. 546)	
[3-12]	Bewertungsdaten für Kernkraftwerksstandorte vom 11. Juni 1975 (Umwelt 1975, Nr. 43)	
[3-13]	Sicherheitskriterien für die Endlagerung radioaktiver Abfälle in einem Bergwerk vom 20. April 1983 (GMBl. 1983, S. 220)	p. 46, 95, 121, 125, 132
[3-15]	1. Rahmenempfehlungen für den Katastrophenschutz in der Umgebung kerntechnischer Anlagen vom 9. August 1999 (GMBl. 1999, Nr. 28/29) 2. Radiologische Grundlagen für Entscheidungen über Maßnahmen zum Schutz der Bevölkerung bei unfallbedingten Freisetzungen von Radionukliden vom 9. August 1999 (GMBl. 1999, Nr. 28/29)	p. 82, 84, 104
[3-23]	Richtlinie zur Emissions- und Immissionsüberwachung kerntechnischer Anlagen (REI) vom 30. Juni 1993 (GMBl. 1993, Nr. 29), in Überarbeitung	p. 46, 76, 78, 103
[3-23-2]	ergänzt um die Anhänge B und C vom 20. Dezember 1995 (GMBl. 1996, Nr. 9/10)	p. 78
[3-24]	Richtlinie über Dichtheitsprüfungen an umschlossenen radioaktiven Stoffen vom 20. August 1996 (GMBl. 1996, Nr. 35), in Überarbeitung	
[3-27]	Richtlinie über die Gewährleistung der notwendigen Kenntnisse der beim Betrieb von Kernkraftwerken sonst tätigen Personen vom 30. November 2000 (GMBl. 2001, S. 153)	p. 66, 67
[3-31]	Empfehlungen zur Planung von Notfallschutzmaßnahmen durch Betreiber von Kernkraftwerken vom 27. Dezember 1976 (GMBl. 1977, S. 48)	
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[3-33]	Leitlinien zur Beurteilung der Auslegung von Kernkraftwerken mit Druckwasserreaktoren gegen Störfälle im Sinne des § 28 Abs. 3 StrlSchV (Störfall-Leitlinien) vom 18. Oktober 1983 (BAnz. 1983, Nr. 245a) Störfallberechnungsgrundlagen für die Leitlinien zur Beurteilung der Auslegung von Kernkraftwerken mit DWR gemäß § 28 Abs. 3 StrlSchV vom 18. Oktober 1983 (BAnz. 1983, Nr. 245a), Neufassung des Kapitels 4 „Berechnung der Strahlenexposition" vom 29. Juni 1994 (BAnz. 1994, Nr. 222a), in Überarbeitung (zu § 45 StrlSchV: siehe Abteilung 2, Allgemeine Verwaltungsvorschrift)	p. 103, 104
[3-34]	Rahmenrichtlinie über die Gestaltung von Sachverständigengutachten in atomrechtlichen Verwaltungsverfahren vom 15. Dezember 1983 (GMBl. 1984, S. 21)	p. 103, 104
[3-36]	Leitsätze für die Unterrichtung der Öffentlichkeit über die Katastrophenschutzplanung in der Umgebung von kerntechnischen Anlagen vom 10. Februar 1978 (Umwelt Nr. 61, 1978) Hinweis: Neueres in 3.15!	
[3-37-1]	Empfehlung über den Regelungsinhalt von Bescheiden bezüglich der Ableitung radioaktiver Stoffe aus Kernkraftwerken mit Leichtwasserreaktor vom 8. August 1984 (GMBl. 1984, S. 327), in Überarbeitung	
[3-38]	Richtlinie für Programme zur Erhaltung der Fachkunde des verantwortlichen Schichtpersonals in Kernkraftwerken vom 1. September 1993 (GMBl. 1993, Nr. 36)	
[3-39]	Richtlinie für den Inhalt der Fachkundeprüfung des verantwortlichen Schichtpersonals in Kernkraftwerken vom 23. April 1996 (GMBl. 1996, Nr. 26), in Überarbeitung	
[3-40]	Richtlinie über die Fachkunde im Strahlenschutz vom 17. September 1982 (GMBl. 1982, S. 592), in Überarbeitung	p. 66, 142
[3-41]	Richtlinie für das Verfahren zur Vorbereitung und Durchführung von Instandhaltungs- und Änderungsarbeiten in Kernkraftwerken vom 1. Juni 1978 (GMBl. 1978, S. 342), in Überarbeitung	
[3-42]	Richtlinie für die physikalische Strahlenschutzkontrolle zur Ermittlung der Körperdosen (§§ 62, 63, 63a StrlSchV; §§35, 35a RöV) vom 20. Dezember 1993 (GMBl. 1994, Nr. 7), in Überarbeitung	
[3-42-1]	Richtlinie für die Ermittlung der Körperdosen bei innerer Strahlenexposition gemäß den §§ 63 und 63a der Strahlenschutzverordnung (Berechnungsgrundlage) vom 13. März 1997 (BAnz. 1997, Nr. 122a), in Überarbeitung	
	Richtlinie für den Strahlenschutz des Personals bei der Durchführung von Instandhaltungsarbeiten in Kernkraftwerken mit Leichtwasserreaktor	
[3-43]	Teil I: Die während der Planung der Anlage zu treffende Vorsorge vom 10. Juli 1978 (GMBl. 1978, S. 418), in Überarbeitung	
[3-43-1]	Teil II: Die Strahlenschutzmaßnahmen während der Inbetriebsetzung und des Betriebs der Anlage vom 4. August 1981 (GMBl. 1981, S. 363), in Überarbeitung	
[3-44]	Kontrolle der Eigenüberwachung radioaktiver Emissionen aus Kernkraftwerken vom 5. Februar 1996 (GMBl. 1996, Nr. 9/10)	
[3-49]	Interpretationen zu den Sicherheitskriterien für Kernkraftwerke Einzelfehlerkonzept - Grundsätze für die Anwendung des Einzelfehlerkriteriums vom 2. März 1984 (GMBl. 1984, S. 208)	
[3-50]	Interpretationen zu den Sicherheitskriterien für Kernkraftwerke vom 17. Mai 1979 (GMBl. 1979, S. 161);zu Sicherheitskriterium 2.6: Einwirkungen von außen ;zu Sicherheitskriterium 8.5: Wärmeabfuhr aus dem Sicherheitseinschluß	

[3-51]	Interpretationen zu den Sicherheitskriterien für Kernkraftwerke vom 28. November 1979 (GMBl. 1980, S. 90) zu Sicherheitskriterium 2.2: Prüfbarkeit zu Sicherheitskriterium 2.3: Strahlenbelastung in der Umgebung zu Sicherheitskriterium 2.6: Einwirkungen von außen zu Sicherheitskriterium 2.7: Brand- und Explosionsschutz ergänzende Interpretation zu Sicherheitskriterium 4.3: Nachwärmeabfuhr nach Kühlmittelverlusten	
[3-52-2]	Erläuterungen zu den Meldekriterien für meldepflichtige Ereignisse in Anlagen zur Spaltung von Kernbrennstoffen (Stand 2/91), ersetzt durch die überarbeitete Fassung 12/97 Zusammenstellung der in den Meldekriterien verwendeten Begriffen (Anlagen zur Spaltung von Kernbrennstoffen) (Stand 2/91) Meldeformular zur Meldung eines meldepflichtigen Ereignisses (Anlagen zur Spaltung von Kernbrennstoffen) (Stand (3/93)	
[3-54]	Rahmenempfehlung für die Fernüberwachung von Kernkraftwerken vom 6. Oktober 1980 (GMBl. 1980, S 577), in Überarbeitung	
[3-54-1]	Empfehlung zur Berechnung der Gebühr nach § 5 AtKostV für die Fernüberwachung von Kernkraftwerken (KFÜ) vom 21. Januar 1983 (GMBl. 1983, S. 146)	
[3-57]	Anforderungen an den Objektsicherungsdienst und an Objektsicherungsbeauftragte in kerntechnischen Anlagen der Sicherungskategorie I vom 8. April 1986 (GMBl. 1986, S. 242)	p. 66
[3-57-1]	Die Richtlinie für die Überprüfung der Zuverlässigkeit von 1996 wurde durch die Atomrechtliche Zuverlässigkeitsüberprüfungs-Verordnung vom 1. Juli 1999 ersetzt siehe (BGBl. I 1999, Nr. 35)	
[3-57-3]	Richtlinie für den Schutz von Kernkraftwerken mit Leichtwasserreaktoren gegen Störmaßnahmen oder sonstige Einwirkungen Dritter vom 6. Dezember 1995 (GMBl. 1996, Nr. 2) (ohne Wortlaut)	
[3-59]	Richtlinie zur Kontrolle radioaktiver Abfälle mit vernachlässigbarer Wärmeentwicklung, die nicht an eine Landessammelstelle abgeliefert werden vom 16. Januar 1989 (BAnz. 1989, Nr. 63a), letzte Ergänzung vom 14. Januar 1994 (Abfallkontrollrichtlinie) (BAnz. 1994, Nr. 19), in Überarbeitung	p. 46, 71, 93, 124
[3-61]	Richtlinie für die Fachkunde von Strahlenschutzbeauftragten in Kernkraftwerken und sonstigen Anlagen zur Spaltung von Kernbrennstoffen vom 10. Dezember 1990 (GMBl. 1991, S. 56), in Überarbeitung	
[3-62]	Richtlinie über Maßnahmen für den Schutz von Anlagen des Kernbrennstoffkreislaufs und sonstigen kerntechnischen Einrichtungen gegen Störmaßnahmen oder sonstige Einwirkungen zugangsberechtigter Einzelpersonen vom 28. Januar 1991 (GMBl. 1991, S. 228)	p. 92, 104
[3-65]	Anforderungen an Lehrgänge zur Vermittlung kerntechnischer Grundlagenkenntnisse für verantwortliches Schichtpersonal in Kernkraftwerken - Anerkennungskriterien - Stand 18. April 1989 (nicht veröffentlicht), Aktualisierung vom 10. Oktober 1994 (nicht veröffentlicht)	
[3-66]	Meldung an die Behörden der Mitgliedstaaten auf dem Gebiet der Sicherungsmaßnahmen gemäß Artikel 79 Abs. 2 des EURATOM-Vertrages vom 12. August 1991 (BAnz. 1991, Nr. 158)	

[3-67]	Richtlinie über Anforderungen an Personendosismeßstellen nach Strahlenschutz- und Röntgenverordnung vom 26. April 1994 (GMBl. 1994, Nr. 33), in Überarbeitung	
	Richtlinie für die Überwachung der Radioaktivität in der Umwelt nach dem Strahlenschutzvorsorgegesetz	
[3-69]	Teil I: Meßprogramm für den Normalbetrieb (Routinemeßprogramm) vom 28. Juli 1994 (GMBl. 1994, Nr. 32), in Überarbeitung	p. 79
[3-69-2]	Teil II: Meßprogramm für den Intensivbetrieb (Intensivmeßprogramm) vom 19. Januar 1995 (GMBl. 1995, Nr. 14), in Überarbeitung	p. 79
[3-71]	Richtlinie für die Fachkunde von verantwortlichen Personen in Anlagen zur Herstellung von Brennelementen für Kernkraftwerke vom 30. November 1995 (GMBl. 1996, Nr. 2)	
[3-72]	Richtlinie über Anforderungen an Inkorporationsmeßstellen vom 30. September 1996 (GMBl. 1996, Nr. 46), in Überarbeitung	
[3-73]	Leitfaden zur Stilllegung von Anlagen nach § 7 des Atomgesetzes vom 14. Juni 1996 (BAnz. 1996, Nr. 211a), in Überarbeitung	p. 46, 120
	Leitfäden zur Durchführung von Periodischen Sicherheitsüberprüfungen (PSÜ) für Kernkraftwerke in der Bundesrepublik Deutschland, in Überarbeitung	
[3-74-1]	- Grundlagen zur Periodischen Sicherheitsprüfung für Kernkraftwerke - Leitfaden Sicherheitsstatusanalyse - Leitfaden Probabilistische Sicherheitsanalyse Bekanntmachung vom 18. August 1997 (BAnz. 1997, Nr. 232a)	
[3-74-2]	- Leitfaden Deterministische Sicherungsanalyse Bekanntmachung vom 25. Juni 1998 (BAnz. 1998, Nr. 153)	

4 Recommendations of the RSK

[4-1]	RSK-Leitlinien für Druckwasserreaktoren 3. Ausgabe vom 14. Oktober 1981 (BAnz. 1982, Nr. 69a) mit den Änderungen in Abschn. 21.1 (BAnz 1984, Nr. 104), in Abschn. 21.2 (BAnz 1983, Nr. 106) und in Abschn. 7 (BAnz 1996, Nr. 158a) mit Berichtigung (BAnz 1996, Nr. 214) und den Anhängen vom 25. April 1979 zu Kapitel 4.2 der 2. Ausgabe der RSK-LL vom 24. Januar 1979 (BAnz. 1979, Nr. 167a) Anhang 1: Auflistung der Systeme und Komponenten, auf die die Rahmenspezifikation Basissicherheit von druckführenden Komponenten anzuwenden ist Anhang 2: Rahmenspezifikation Basissicherheit: Basissicherheit von druckführenden Komponenten: Behälter, Apparate, Rohrleitungen, Pumpen und Armaturen (ausgenommen: Einbauteile, Bauteile zur Kraftübertragung und druckführende Wandungen < DN 50)	
[4-2]	Sicherheitstechnische Leitlinien für die trockene Zwischenlagerung bestrahlter Brennelemente in Behältern, Empfehlung der RSK, Anlage 1 zum Ergebnisprotokoll der 338. Sitzung der Reaktor-Sicherheitskommission am 01.03.2001	p. 46, 93, 95, 96, 101, 103, 104, 120
[4-3]	Sicherheitsanforderungen an die längerfristige Zwischenlagerung schwach- und mittelradioaktiver Abfälle, Empfehlung der RSK, Anlage 1 zum Ergebnisprotokoll der 357. Sitzung der Reaktor-Sicherheitskommission am 05.12.2002	p. 113, 123

5 Rules of the Nuclear Safety Standards Commission (KTA)

Rule no. KTA	Title	Most recent edition	Published in *Bundesanzeiger* / Federal Gazette No. dated	Earlier versions	Continued validity confirmed	Engl. trans-lation
	1000 Internal KTA procedural regulations					
	1100 Terms and definitions		-		-	-
	(glossary by KTA-GS)	1/96		6/91		
	1200 General, administration, organization					
1201	Requirements for the operating manual	6/98	172 a 15/09/98	2/78; 3/81; 12/85	12/06/90	+
1202	Requirements for the testing manual	6/84	191 a 09/10/84 enclosure 51/84	-	14/06/94	+
	1300 Radiological aspects of industrial safety					
1301.1	Radiation protection considerations for plant personnel in the design and operation of nuclear power plants; Part 1: Design	11/84	40 a 27/02/85	-	14/06/94	+
1301.2	Radiation protection considerations for plant personnel in the design and operation of nuclear power plants; Part 2: Operation	6/89	158 a 24/08/89 Addendum 118 29/06/91	6/82	14/06/94	+
	1400 Quality assurance					
1401	General requirements regarding quality assurance	6/96	216 a 19/11/96	2/80; 12/87		+
1404	Documentation during the construction and operation of nuclear power plants	6/89	158 a 24/08/89	-	14/06/94	+
1408.1	Quality assurance for weld filler materials and weld additives for pressure and activity retaining system in nuclear power plants; Part 1: Suitability testing	6/85	203 a 29/10/85	-	11/06/96	+
1408.2	Quality assurance for weld filler materials and weld additives for pressure and activity retaining system in nuclear power plants; Part 2: Manufacturing	6/85	203 a 29/10/85 Addendum 229 10/12/86	-	11/06/96	+
1408.3	Quality assurance for weld filler materials and weld additives for pressure and activity retaining system in nuclear power plants; Part 3: Processing	6/85	203 a 29/10/85	-	11/06/96	+
	1500 Radiological protection and monitoring					
1501	Stationary system for monitoring area dose rates within nuclear power plants	6/91	7 a 11/01/92	10/77	11/06/96 1)	-

Rule no. KTA	Title	Most recent edition	Published in *Bundesanzeiger* / Federal Gazette No. dated	Earlier versions	Continued validity confirmed	Engl. trans-lation
1502.1	Monitoring radioactivity in the inner atmosphere of nuclear power plants; Part 1: Nuclear power plants with light water reactors	6/86	162 a 03/09/86 Addendum 195 15/10/88	-	11/06/96	+
(1502.2)	Monitoring radioactivity in the inner atmosphere of nuclear power plants; Part 2: Nuclear power plants with high temperature reactor	6/89	229 a 07/12/89	-	-	+
1503.1	Monitoring and assessing the discharge of gaseous and aerosol-bound radioactive substances; Part 1: Monitoring and assessing the stack discharge of radioactive substances during specified normal operation	6/93	211 a 09/11/93	2/79	-	-
1503.2	Monitoring and assessing the discharge of gaseous and aerosol-bound radioactive substances; Part 2: Monitoring and assessing the stack discharge of radioactive substances during anticipated operational occurrences and accident conditions	6/99	243 b 23/12/99	-	-	-
1503.3	Monitoring and assessing the discharge of gaseous and aerosol-bound radioactive substances; Part 3: Monitoring and assessing radioactive substances not discharged via the stack	6/99	243 b 23/12/99	-	-	-
1504	Monitoring and assessing the discharge of radioactive substances in liquid effluents	6/94	238 a 20/12/94 Addendum 216 a 19/11/96	6/78	-	-
1506	Measuring local dose rates in exclusion areas of nuclear power plants	6/86	162 a 03/09/86 Addendum 229 10/12/86	-	11/06/96	+
1507	Monitoring and assessing the discharges of radioactive substances from research reactors	6/98	172 a 15/09/98	3/84	-	-
1508	Instrumentation to determine atmospheric diffusion of radioactive substances	9/88	37 a 22/02/89	-	15/06/93	+
	2100 Plant					
2101.1	Fire protection in nuclear power plants; Part 1: Basic principles	12/85	33 a 18/02/86	-	-	+
2103	Explosion protection in nuclear power plants with light water reactors (general and case-related requirements)	6/89	229 a 07/12/89	-	14/06/94 1)	+
	2200 External events					
2201.1	Design of nuclear power plants against seismic events; Part 1: Principles	6/90	20 a 30/01/91	6/75	13/06/95	+

Rule no. KTA	Title	Most recent edition	Published in *Bundesanzeiger* / Federal Gazette No. dated	Earlier versions	Continued validity confirmed	Engl. trans-lation
2201.2	Design of nuclear power plants against seismic events; Part 2: Subsurface materials (soil and rock)	6/90	20 a 30/01/91	11/82	13/06/95	+
2201.4	Design of nuclear power plants against seismic events; Part 4: Requirements for procedures for verifying the safety of mechanical and electrical components against earthquakes	6/90	20 a 30/01/91 Addendum 115 25/06/96	-	13/06/95	+
2201.5	Design of nuclear power plants against seismic events; Part 5: Seismic instrumentation	6/96	216 a 19/11/96	6/77; 6/90	-	+
2201.6	Design of nuclear power plants against seismic events; Part 6: Post-seismic measures	6/92	36 a 23/02/93	-	10/06/97	+
2206	Design of nuclear power plants against lightning effects	6/00	159 a 24/08/00	6/92	-	-
2207	Flood protection for nuclear power plants	6/92	36 a 23/02/93	6/82	-	+
	2500 Civil engineering					
2501	Waterproofing of structures of nuclear power plants	9/88	37 a 22/02/89	-	14/06/94	+
2502	Mechanical design of fuel storage pools in nuclear power plants with light water reactors	6/90	20 a 30/01/91	-	13/06/95	+
	3000 Systems in general					
	3100 Reactor core and reactor control					
3101.1	Design of reactor cores of pressurized water and boiling water reactors; Part 1 Principles of thermohydraulic design	2/80	92 20/05/80	-	13/06/95	+
3101.2	Design of reactor cores of pressurized water and boiling water reactors; Part 2: Neutron-physical requirements for design and operation of the reactor core and adjacent systems	12/87	44 a 04/03/88	-	10/06/97	+
(3102.1)	Design of reactor cores of high temperature gas-cooled reactors; Part 1: Calculation of the material properties of helium	6/78	189 a 06/10/78 Enclosure 23/78	-	20/09/88	+
(3102.2)	Reactor core design for high temperature gas-cooled reactors; Part 2: Heat transfer in spherical fuel elements	6/83	194 14/10/83 Enclosure 47/83	-	20/09/88	+
(3102.3)	Reactor core design for high temperature gas-cooled reactors; Part 3: Loss of pressure through friction in pebble bed cores	3/81	136 a 28/07/81 Enclosure 24/81	-	11/06/91	+
(3102.4)	Reactor core design for high temperature gas-cooled reactors; Part 4: Thermohydraulic analytical model for stationary and quasi-stationary conditions in pebble bed cores	11/84	40 a 27/02/85 Addendum 124 07/07/89	-	27/06/89	+

Rule no. KTA	Title	Most recent edition	Published in *Bundesanzeiger* / Federal Gazette No. dated	Earlier versions	Continued validity confirmed	Engl. trans-lation
(3102.5)	Reactor core design for high temperature gas-cooled reactors; Part 5: Systematic and statistical errors in the thermohydraulic core design of the pebble bed reactor	6/86	162 a 03/09/86	-	11/06/91	+
3103	Shutdown systems of light water reactors	3/84	145 a 04/08/84 Enclosure 39/84	-	14/06/94	+
3104	Determination of the shutdown reactivity	10/79	19 a 29/01/80 Enclosure 1/80	-	14/06/94	+
	3200 Primary and secondary circuits					
3201.1	Components of the reactor coolant pressure boundary of light water reactors; Part 1: Materials and product forms	6/98	170 a 11/09/98	2/79; 11/82; 6/90	-	+
3201.2	Components of the reactor coolant pressure boundary of light water reactors; Part 2: Design and analysis	6/96	216 a 19/11/96	10/80; 3/84	-	+
3201.3	Components of the reactor coolant pressure boundary of light water reactors; Part 3: Manufacture	6/98	219 a 20/11/98	10/79; 12/87	-	+
3201.4	Components of the reactor coolant pressure boundary of light water reactors; Part 4: In-service inspections and operational monitoring	6/99	200 a 22/10/99	6/82; 6/90	-	-
3203	Monitoring radiation embrittlement of materials of the reactor pressure vessel of light water reactors	3/84	119 a 29/06/84 Enclosure 33/84	-	13/06/95	+
3204	Reactor pressure vessel internals	6/98	236 a 15/12/98	3/84	-	-
3205.1	Component support structures with non-integral connections; Part 1: Component support structures with non-integral connections for components of the reactor coolant pressure boundary	6/91	118 a 30/06/92 Addendum 111 17/06/94	6/82	-	+
3205.2	Component support structures with non-integral connections; Part 2: Component support structures with non-integral connections for pressure and activity-retaining components in systems outside the primary circuit	6/90	41 a 28/02/91	-	13/06/95	+
3205.3	Component support structures with non-integral connections; Part 3: Series-production standard supports	6/89	229 a 07/12/89 Addendum 111 17/06/94	-	14/06/94	+
3211.1	Pressure and activity-retaining components of systems outside the reactor coolant pressure boundary; Part 1: Materials	6/00	194 a 14/10/00	6/91	-	-
3211.2	Pressure and activity-retaining components of systems outside the reactor coolant pressure boundary; Part 2: Design and analysis	6/92	165 a 03/09/93 Addendum 111 17/06/94	-	-	+

Rule no. KTA	Title	Most recent edition	Published in *Bundesanzeiger* / Federal Gazette No. dated	Earlier versions	Continued validity confirmed	Engl. trans-lation
3211.3	Pressure and activity-retaining components of systems outside the reactor coolant pressure boundary; Part 3: Manufacture	6/90	41 a 28/02/91	-	10/06/97	-
3211.4	Pressure and activity-retaining components of systems outside the reactor coolant pressure boundary; Part 4: In-service inspections and operational monitoring	6/96	216 a 19/11/96	-	-	-
	3300 Heat removal					
3301	Residual heat removal systems of light water reactors 2)	11/84	40 a 27/02/85	-	14/06/94	+
3303	Heat removal systems for fuel assembly storage pools in nuclear power plants with light water reactors	6/90	41 a 28/02/91	-	13/06/95	+
	3400 Containment					
3401.1	Steel containment vessels; Part 1: Materials and product forms	9/88	37 a 22/02/89	6/80; 11/82	15/06/93	-
3401.2	Steel containment vessels; Part 2: Analysis and design	6/85	203 a 29/10/85	6/80	13/06/95	+
3401.3	Steel containment vessels; Part 3: Manufacture	11/86	44 a 05/03/87	10/79	10/06/97	+
3401.4	Steel containment vessels; Part 4: In-service inspections	6/91	7 a 11/01/92	3/81	11/06/96	-
3402	Air locks through the containment vessel of nuclear power plants – Personnel locks	11/76	38 24/02/77	-	14/06/94	+
3403	Cable penetrations through the reactor containment vessel	10/80	44 a 05/03/81 Enclosure 6/81	11/76	11/06/96	+
3404	Isolation of operating system pipes penetrating the containment vessel in the case of a release of radioactive substances into the containment vessel	9/88	37 a 22/02/89 Addendum 119 30/06/90		15/06/93	+
3405	Integral leakage rate testing of the containment vessel with the absolute pressure method	2/79	133 a 20/07/79 Enclosure 27/79	-	14/06/94	+
3407	Pipe penetrations through the reactor containment vessel	6/91	113 a 23/06/92	-	11/06/96	+
3409	Air-locks for the reactor containment vessel for nuclear power plants – Material locks	6/79	137 26/07/79	-	14/06/94	+
3413	Determination of loads for the design of a full pressure containment vessel against plant-internal incidents	6/89	229 a 07/12/89	-	14/06/94	+
	3500 Instrumentations and reactor protection					
3501	Reactor protection system and monitoring equipment of the safety system	6/85	203 a 29/10/85	3/77	13/06/95	+

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3502	Accident overview measuring systems	6/99	243 b 23/12/99	11/82; 11/84	-	-
3503	Type testing of electrical modules for the reactor protection system	11/86	93 a 20/05/87	6/82	10/06/97	+
3504	Electrical drives of the safety system in nuclear power plants	9/88	37 a 22/02/89	-	15/06/93	-
3505	Type testing of measuring transmitters and transducers of the reactor protection system	11/84	40 a 27/02/85	-	10/06/97	+
3506	Tests and inspections of the instrumentation and control equipment of the safety system of nuclear power plants	11/84	40 a 27/02/85	-	10/06/97	+
3507	Factory tests, post-repair tests and demonstration of successful service for the instrumentation and control equipment of the safety system	11/86	44 a 05/03/87	-	11/06/96	+
	<u>3600 Activity control and activity management</u>					
3601	Ventilation and air filtration systems in nuclear power plants	6/90	41 a 28/02/91	-	13/06/95 1)	-
3602	Storage and handling of nuclear fuel assemblies, control rods and neutron sources in nuclear power plants with light water reactors	6/90	41 a 28/02/91	6/82; 6/84	13/06/95	-
3603	Facilities for treating radioactively contaminated water in nuclear power plants	6/91	7 a 11/01/92	2/80	11/06/96 1)	+
3604	Storaging, handling and on-site transportation of radioactive substances (other than fuel elements) in nuclear power plants	6/83	194 14/10/83 Enclosure 47/83	-	14/06/94	+
3605	Treatment of radioactively contaminated gases in nuclear power plants with light water reactors	6/89	229 a 07/12/89	-	14/06/94	+
	<u>3700 Energy and media supply</u>					
3701	General requirements for the electrical power supply in nuclear power plants	6/99	243 b 23/12/99	3701.1 (6/78) 3701.2 (6/82) 6/97	-	-
3702	Emergency power generating facilities with diesel-generator units in nuclear power plants	6/00	159 a 24/08/00	3702.1 (6/88) 3702.2 (6/91)	-	-
3703	Emergency power generating facilities with batteries and rectifier units in nuclear power plants	6/99	243 b 23/12/99	6/86	-	-

Rule no. KTA	Title	Most recent edition	Published in *Bundesanzeiger* / Federal Gazette No. dated	Earlier versions	Continued validity confirmed	Engl. trans-lation
3704	Emergency power facilities with rotary converters and static inverters in nuclear power plants	6/99	243 b 23/12/99	6/84	-	-
3705	Switchgear facilities, transformers and distribution networks for the electrical power supply of the safety system in nuclear power plants	6/99	243 b 23/12/99	9/88	-	-
3706	Measures to preserve resistance of electrical and I & C components against loss of coolant accident conditions of operating nuclear power plants	6/00	159 a 24/08/00	-	-	-
	3900 Other systems					
3901	Communication devices for nuclear power plants	3/81	136 a 28/07/81 Enclosure 24/81 Addendum 155 22/08/81	3/77	11/06/96	+
3902	Lifting equipment in nuclear power plants	6/99	144 a 05/08/99	11/75; 6/78; 11/83; 6/92	-	-
3903	Inspection, testing and operation of lifting equipment in nuclear power plants	6/99	144 a 05/08/99	11/82; 6/93	-	-
3904	Control room, emergency control room and local control stations in nuclear power plants	9/88	37 a 22/02/89	-	15/06/93	+
3905	Load attaching points on loads in nuclear power plants	6/99	200 a 22/10/99	-	-	-

( ) HTR rule which is no longer included in monitoring to section 5.2 of the KTA procedural instruction and is no longer available for purchase via Carl Heymanns Verlag KG.
1) The HTR specifications in this rule were also deleted at the same time.
2) At its 43rd meeting on 17 June 1989, the KTA adopted the “Instructions for users of rule KTA 3301 (11/84)".

(g) References to Official National and International Reports Related to Safety

Official National Reports

1. *Produktkontrolle radioaktiver Abfälle – Schachtanlage Konrad* – last updated 1995; edited by: Berndt-Rainer Martens; Salzgitter, December 1995; BfS ET-IB-45-REV-3
2. *Anforderungen an endzulagernde radioaktive Abfälle (Endlagerungsbedingungen, Stand: Dezember 1995) – Schachtanlage Konrad*; edited by Peter Brennecke; Salzgitter, December 1995; BfS ET-IB-79
3. *Anforderungen an endzulagernde radioaktive Abfälle und Maßnahmen zur Produktkontrolle radioaktiver Abfälle Endlager für radioaktive Abfälle Morsleben (ERAM) Teil I: Endlagerungsbedingungen, Stand: August 1996*; edited by Karin Kugel, Werner Noack, Heinz Giller, Berndt-Rainer Martens, Peter Brennecke; Salzgitter, August 1996; BfS ET-IB-85
4. *Anforderungen an endzulagernde radioaktive Abfälle und Maßnahmen zur Produktkontrolle radioaktiver Abfälle Endlager für radioaktive Abfälle Morsleben (ERAM) Teil II: Produktkontrolle, Stand: Dezember 1996*; edited by Berndt-Rainer Martens, Heinz Giller, Peter Brennecke; Salzgitter, December 1996; BfS ET-IB-85/2
5. *Anfall radioaktiver Abfälle in der Bundesrepublik Deutschland – Abfallerhebung für das Jahr 1998*; P. Brennecke, A. Hollmann; Salzgitter 1999; BfS ET 30/00
6. *Anfall radioaktiver Abfälle in der Bundesrepublik Deutschland – Abfallerhebung für das Jahr 1999*; P. Brennecke, A. Hollmann; Salzgitter April 2001; BfS ET 35/01
7. *Zusammenstellung der Genehmigungswerte für Ableitungen radioaktiver Stoffe mit der Fortluft und dem Abwasser aus kerntechnischen Anlagen der BRD (Stand Juli 2000)*; H. Klonk, J. Hutter, F. Philippczyk, Chr. Wittwer; Salzgitter 2000; BfS-KT-25/00
8. *Statusbericht zur Kernenergienutzung in der Bundesrepublik Deutschland 2001*; F. Philippczyk, J. Hutter, I. Schmidt; Salzgitter 2002; BfS-KT-27/02
9. Jahresbericht 2001 Bundesamt für Strahlenschutz *(Annual Report by the Federal Office for Radiation Protection)*; Salzgitter 2000
10. *Methoden und Anwendungen geostatistischer Analysen*; K.-J. Röhling; BMU 1999-529
11. *Sicherheit in der Nachbetriebsphase von Endlagern für radioaktive Abfälle*; K.-J. Röhling, B. Baltes, A. Becker, P. Bogorinski, H. Fischer K. Fischer-Appelt, V. Javeri, L. Lambers, K.-H. Martens, G. Morlock, B. Pöltl; BMU 1999-535
12. *Stellungnahme zum Stand der Entwicklung des Verfüll- und Verschließkonzeptes des Endlagers Morsleben (ERAM)*; R. S. Wernicke; BMU 1999-539
13. *Sicherheitstechnische Bewertung des Einlagerungsbetriebs im Endlager für radioaktive Abfälle Morsleben (ERAM) – Abschlussbericht* -; U. Oppermann, F. Peiffer; BMU 2000-547
14. *Sicherheitstechnische Bewertung des Einlagerungsbetriebs im Endlager für radioaktive Abfälle Morsleben (ERAM) – Berichtsband* – L. Ackermann, B. Baltes, J. Larue, H.-G. Mielke, U. Oppermann, F. Pfeiffer; BMU 2000-549
15. *Unsicherheits- und Sensitivitätsanalysen für Grundwasser- und Transportmodelle auf der Basis geostatistischer Untersuchungen*; K.-J. Röhling, B. Pöltl; BMU 2000-551

16. *Stellungnahme zu sicherheitstechnisch relevanten Erkenntnissen im Endlager Morsleben und Konsequenzen*; R. S. Wernicke; BMU 2000-552

17. *Simulation von Lüftungssystemen in Anlagen des Brennstoffkreislauf durch Erweiterung des Rechenprogramms FIPLOC*; G. Weber; BMU 2000-553

18. *Nuklidtransport bei salzanteilabhängiger Adsorption*; V. Javeri; BMU 2000-556

19. *Freigabe von Gebäuden und Bauschutt*; S. Thierfeldt, E. Kugeler; BMU 2000-558

20. *Flächenbezogene Freigabe und Freigabe von flüssigen Reststoffen*; A. Deckert, S. Thierfeldt, E. Kugeler; BMU 2000-559

21. *Grundsätzliche Aspekte für Verschlussbauwerke im Salinar – Stellungnahme zu einem Modell*; B. Baltes, R. S. Wernicke; BMU 2000-560

22. *Internationale Entwicklung zur Beurteilung der langzeitigen Sicherheit von Endlagern für HAW und abgebrannte Brennelemente*; B. Baltes; BMU 2001-562

23. *Geotechnische Nachweiskonzepte für Endlager im Salinar*; H.-G. Mielke; BMU 2001-580

24. *Betrachtungen zur Langzeitsicherheit und Machbarkeit anhand der TILA-99-Studie*; J. Larue; BMU 2001-581

25. *Nichtlineare Sorptionsansätze zur Beurteilung der Langzeitsicherheit*; K. Fischer-Appelt, H. Fischer, V. Javeri, K.-H. Martens, K. Röhling, E. Schrödl; BMU 2001-583

26. *Stabilitäts- und Integritätskriterien für salinare Strukturen*; V. Javeri, H.-G. Mielke; BMU 2001-585

27. *Migration von Salzlösung im ERAM*; K. Fischer-Appelt, J. Larue; BMU 2002-595

28. *Vergleich Untertagedeponien – Endlager*; Pieper, Resele, Skrzyppek, Wilke; BMU 2002-599

29. *Tongestein und Endlagerung radioaktiver Abfälle*; Th. Beuth; BMU 2002-603

30. *Erarbeitung einer optimierten Entsorgungsstrategie für Abfälle und Reststoffe aus Kernkraftwerken (Entsorgungsstrategie für radioaktive Abfälle)*; A. Nüsser, S. Thierfeldt, E. Kugeler, D. Gründler, D. Maric; BMU 2002-607

31. *Nuklidtransport – Salinität und nichtlineare Adsorption in der Gorlebener Rinne*; V. Javeri; BMU 2002-608

Official International Reports

1. Radioactive Waste Arisings in the Federal Republic of Germany, 1998 Waste Inquiry; P. Brennecke, A. Hollmann, Salzgitter, 2000; BfS ET 33/00

2. Radioactive Waste Arisings in the Federal Republic of Germany, 1999 Waste Inquiry; P. Brennecke, A. Hollmann, Salzgitter, 2001; BfS ET 36/01

3. Stochastic and Deterministic Analyses for a Generic Repository in Rock Salt in the EU-Project SPA “Spent Fuel Performance Assessment”, K.-H. Martens, H. Fischer, E. Hofer, B. Krzykacz, BMU 2000-550

4. *Betrachtungen zur Langzeitsicherheit und Machbarkeit eines Endlagers Yucca-Mountain*, H.-G. Mielke, BMU 2001-582

5. *Vergleich der Umweltverträglichkeitsprüfungen von Endlagern in Deutschland, Finnland und den USA*, H.-G. Mielke, BMU 2002-601

6. *Japanische Sicherheitsstudie zur Endlagerung*, L. Lambers, BMU 2002-602

(h) References to Reports of International Review Missions Performed at the Request of a Contracting Party

(i) Other Relevant Material

These documents may be used in the licensing and supervising procedure by the regulatory body if required.

[ABVO 96]	Allgemeine Bergverordnung über Untertagebetriebe, Tagebaue und Salinen vom 02. Februar 1966 (Nds. MBl. S. 337), zuletzt geändert durch die Bekanntmachung des Bundesministeriums für Wirtschaft nach § 25 der Allgemeinen Bundesbergverordnung über gegenstandslose landesrechtliche Vorschriften vom 10. Januar 1996 (BAnz 1996 S. 729)	p. 132
[AGE 92]	Agenda 21, Konferenz der Vereinten Nationen für Umwelt und Entwicklung im Juni 1992 in Rio de Janeiro – Dokumente -	p. 9
[AKEnd 02]	Empfehlungen des AkEnd – Arbeitskreis Auswahlverfahren Endlagerstandorte, Dezember 2002	p. 118
[ANT 78]	Antarktisvertrag BGBl. 1978 II S. 1517; UNTS Vol. 402 S. 71	p. 138
[BfS 95]	Bundesamt für Strahlenschutz (BfS), Anforderungen an endzulagernde radioaktive Abfälle (Endlagerungsbedingungen, Stand: September 1994) – Schachtanlage Konrad - Salzgitter, Dezember 1995, ET-IB-79	p. 14,17
[BfS 02]	Jahresbericht des Bundesamtes für Strahlenschutz für 2000 „Umweltradioaktivität und Strahlenbelastung“, April 2002	p. 142
[BMU 99]	Übersicht über Maßnahmen zur Verringerung der Strahlenexposition nach Ereignissen mit nicht unerheblichen radiologischen Auswirkungen“, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Oktober 1999	p. 82, 84
[BMU 99a]	Handbuch Reaktorsicherheit und Strahlenschutz, Band 1, Teil D „Bilaterale Vereinbarungen im Rahmen der Kerntechnik und des Strahlenschutzes“, fortlaufende Aktualisierung	p. 84
[BMU 00]	Sicherung von Zwischenlagern für bestrahlte Brennelemente aus Leichtwasserreaktoren an Kernkraftwerksstandorten in Transport- und Lagerbehältern gegen Störmaßnahmen oder sonstige Einwirkungen Dritter; BMU-Erlass vom 1. Dezember 2000, RS I 3 - 14640 - 1/7 VS-NfD	p. 92, 104
[BUN 00]	Vereinbarung zwischen der Bundesregierung und den Energieversorgungsunternehmen vom 14. Juni 2000 („Konsensvereinbarung“)	p. 7, 9
[DIN 25401]	Begriffe der Kerntechnik DIN 25401-1: Begriffe der Kerntechnik - Physikalische und chemische Grundlagen DIN 25401-2: Begriffe der Kerntechnik; Reaktorauslegung DIN 25401-3: Begriffe der Kerntechnik - Reaktortechnik und Betrieb DIN 25401-4: Begriffe der Kerntechnik; Kernmaterialüberwachung DIN 25401-5: Begriffe der Kerntechnik; Brennstofftechnologie DIN 25401-6: Begriffe der Kerntechnik – Isotopentrennung DIN 25401-7: Begriffe der Kerntechnik; Sicherheit kerntechnischer Anlagen DIN 25401-8: Begriffe der Kerntechnik; Strahlenschutz DIN 25401-9: Begriffe der Kerntechnik; Entsorgung	p. 15
[DIN 25403]	Kritikalitätssicherheit bei der Herstellung und Handhabung von Kernbrennstoffen, DIN 25403 Teil 1, Grundsätze vom Dezember 1991	p. 103
[DIN 25474]	Maßnahmen administrativer Art zur Einhaltung der Kritikalitätssicherheit in kerntechnischen Anlagen ausgenommen Reaktoren, Juli 1996	p. 103

[EUR 92]	Council Directive 92/3/Euratom of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community Official Journal of 12 February 1992, No. L 35 page 24	p. 141
[EUR 93]	Council Regulation (Euratom) No. 1493/93 of 8 June 1993 on shipments of radioactive materials between Member States (OJ L 148/1)	p. 144
[EUR 96]	Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances ("Seveso II Directive") (OJ No. L 10 of 14 January 1997, page 13)	p. 18
[EUR 97a]	Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionizing radiation in relation to medical exposure, and repealing Directive 84/466/Euratom	p. 71
[EUR 02]	Proposal for a Council Directive on the control of high activity sealed radioactive sources; Official Journal No. C 151 E of 25/06/2002, page 0298 – 0304	p. 141
[GG 49]	Grundgesetz für die Bundesrepublik Deutschland (GG) vom 23. Mai 1949 (BGBl. S. 1), zuletzt geändert durch Art. 1 G v. 26. Juli 2002 I 2863 Maßgaben aufgrund des EinigVtr vgl. GG Anhang EV	p. 10, 44, 60
[HGB 02]	Handelsgesetzbuch, Gesetz vom 10. Mai 1897 (RGBl. S. 219), zuletzt geändert durch Gesetz vom 19. Juli 2002 (BGBl. I S. 2681) m. W. v. 26. Juli 2002	p. 68
[IAEA 94]	Design of Spent Fuel Storage Facilities (1994), IAEA Safety Series No. 116, Vienna, 1994	p. 103
[IAEA 94a]	Operation of Spent Fuel Storage Facilities (1994), IAEA Safety Series No. 117, Vienna, 1994	p. 103
[IAEA 94b]	Safety Assessment for Spent Fuel Storage Facilities, IAEA Safety Series No. 118, Vienna, 1994	p. 94
[IAEA 95]	Principles of Radioactive Waste Management: A Safety Fundamental, Safety Series No. 111-F, STI/PUB/989, Vienna, 1995	p. 11, 16, 95
[IAEA 96]	International Basic Safety Standards for Protection against radiation and for the safety of radiation sources, Vienna, 1996	p. 18, 71, 83
[IAEA 96a]	International Atomic Energy Agency: Regulations for the Safe Transport of Radioactive Material, 1996 Edition (revised), No. TS-R-1 (ST-1, Revised)	p. 104
[IAEA 96F]	Radiation Protection and the Safety of Radiation Sources: A Safety Fundamental, Safety Series No. 120, STI/PUB/1000, Vienna, 1996	p. 11
[IAEA 00]	Categorisation of Radiation Sources, IAEA, TECDOC 1191, Vienna, 2000	p. 141
[IAEA 00a]	Predisposal Management of Radioactive Waste, Including Decommissioning, Safety Requirements No. WS-R-2, July 2000	p. 111
[IAEA 01]	Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, Vienna, 2001	p. 141
[IAEA 02]	Core Management and Fuel Handling for Nuclear Power Plants, IAEA Safety Guide No NS-G-2.5, Vienna, 2002	p. 94
[ICRP 77]	ICRP Publication 26 (Annals of the ICRP Vol. 1 No. 3, 1977), Recommendations of the ICRP	p. 38
[ICRP 81]	ICRP Publication 32 (Annals of the ICRP Vol. 6 No. 1, 1981). Limits of Inhalation of Radon Daughters by Workers	p. 38
[ICRP 84]	ICRP Publication 40 (Annals of the ICRP Vol. 14 No. 2, 1984), Protection of the Public in the Event of Major Radiation Accidents: Principles for Planning	p. 83

[ICRP 93]	ICRP Publication 63 (Annals of the ICRP Vol. 22 No. 4, 1993), Principles for Intervention for Protection of the Public in a Radiological Emergency	p. 82
[Linien 56]	Vereinbarung über den Durchflug im internationalen Linienverkehr (BGBl. 1956 II S. 442)	p. 139
[Mosel 57]	Vertrag vom 27. Oktober 1956 über die Schiffbarmachung der Mosel (BGBl. 1956 II S. 1837, 1957 II S. 2)	p. 139
[Rhein 68]	Revidierte Rheinschifffahrtsakte vom 17. Oktober 1868 in der Fassung der Bekanntmachung vom 11. März 1969 (BGBl. 1969 II S. 597)	p. 139
[UNCLOS 94]	Gesetz zu dem Seerechtsübereinkommen der Vereinten Nationen vom 10. Dezember 1982 (BGBl. 1994 II S. 1798)	p. 139

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