

**Guide to the decommissioning, the safe enclosure and the dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act**

**as of 26.06.2009**

Unofficial translation by the UK Health and Safety Executive and GRS  
In case of discrepancies between the English translation and the German original,  
the original shall prevail.

## Contents

1. Introduction .....	3
2. Framework .....	5
2.1 Principles.....	5
2.2 Legal regulations.....	6
2.3 Technical rules .....	9
2.4 International regulations, standards and recommendations.....	11
3. Decommissioning planning and application documents.....	14
3.1 Decommissioning strategies .....	14
3.2 Decommissioning concept .....	16
3.3 Application documents .....	17
3.4 Safety considerations.....	20
3.5 Definition of decontamination and dismantling techniques .....	22
3.6 Staffing provisions.....	24
3.7 Financial security.....	24
4. Licensing procedure.....	26
4.1 Checking the preconditions for licensing.....	26
4.2 Transition from operating license to decommissioning license .....	26
4.3 Licensing procedure with several steps .....	27
4.4 Environmental impact assessment and involvement of third parties.....	29
5. Supervision .....	31
5.1 Permit of decommissioning work.....	31
5.2 Documentation .....	33
6. Handling of radioactive and non-radioactive materials from decommissioning.....	35
6.1 Release from nuclear supervision .....	36
6.2 Measurement methods and sampling .....	36
6.3 Clearance.....	38
6.4 Removal.....	41
6.5 Treatment and storage of radioactive substances .....	42
7. Literature.....	46
8. Annex 1: Definition of terms .....	49
9. Annex 2: Classification of the BMI/BMU and KTA standards in respect to their applicability to decommissioning.....	56
10. Annex 3: Comments on application adapted to protection objectives or partial application of the BMI/BMU announcements and KTA standards in decommissioning procedures.....	68
11. Annex 4: Application documents for decommissioning, safe enclosure and dismantling of nuclear facilities in the Federal Republic of Germany ...	85

## 1. Introduction

From the decommissioning procedures of nuclear facilities which have so far taken place in the Federal Republic of Germany it has been demonstrated that, with respect to technical execution of this work and also the technical rules and legal regulations which must be applied, adequate means exist to allow decommissioning projects to be licensed and decommissioning procedures to be carried out safely.

In the licenses which have so far been issued under the terms of § 7, para. 3 of the Atomic Energy Act (AtG), the licensing authorities stipulated the requirements for decommissioning and safe enclosure or the dismantling of facilities or parts thereof, in some cases with analogous application of the rules and guidelines which exist for construction and operation of the facilities. Relevant parts of the requirements were tailored to suit the specific conditions with regard to the decommissioning and safe enclosure or the dismantling of the facility.

In view of the large number of decommissioning projects which are to be carried out in the future, the aim of the guide is,

- to summarise the aspects of licensing and supervision which are relevant in the decommissioning procedure,
- to achieve a common understanding between the Federal Government and the *Länder* to ensure that decommissioning is done appropriately, and
- to harmonise the existing interpretations and procedures where possible.

Consequently, the decommissioning guide includes proposals for an appropriate procedure for the decommissioning, safe enclosure and dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act in respect of the application of the technical rules for the planning and preparation of decommissioning measures as well as for licensing and supervision. These proposals are primarily aimed at the decommissioning procedures of nuclear power plants. It may be that the conditions are different for research reactors and nuclear fuel cycle facilities and these need to be considered specifically for these facilities.

Annex 1 of the guide provides an explanation of the main terms which are used in this guide. So, the word “decommissioning” is used both as single word and as compound term (e.g. decommissioning procedure) in this guide generally in the wider sense as generic term for all activities aimed at decommissioning (including safe enclosure and dismantling). This is in accordance with the technical and international parlance. In the Atomic Energy Act, however, reference is made to “decommissioning, safe enclosure and dismantling”. There, the term “decommissioning” is thus used in a narrower legal sense. In the guide, this narrower legal usage of the word “decommissioning“ is only applied by way of exception if in the text direct reference is made to the Atomic Energy Act or if decommissioning, safe enclosure and dismantling are listed.

This revised guide replaces the guide to the decommissioning of facilities of 14.06.1996 and represents a document in which the relevant aspects for future decommissioning procedures and the aids appropriate for their implementation are summarised. It also can already be used as guidance in ongoing procedures in so far as the competent authority considers it expedient.

## **2. Framework**

### **2.1 Principles**

On the basis of the protection objectives of § 1 of the Atomic Energy Act (AtG), also in agreement with international recommendations /1/, /2/, /3/, the ultimate objective of all decommissioning measures is to release the nuclear facility from nuclear supervision. The decommissioning measures can also terminate by conversion of the remaining part of the facility, which is not yet released, to another use licensed under nuclear or radiation protection legislation.

Under the terms of § 7, para. 3 of the Atomic Energy Act, decommissioning, safe enclosure and dismantling of the facility or parts of a facility are subject to licensing. For the release of the radioactive substances produced by it and of movable goods, buildings, soil areas, facilities or parts of facilities, which are activated or contaminated, from supervision governed by the Atomic Energy Act or radiation protection legislation, clearance, i.e. an administrative act, is required according to § 29 of the Radiation Protection Ordinance (StrlSchV). Substances and movable goods, buildings, soil areas, facilities or parts of facilities which are covered by a license under § 7, para. 1 of the Atomic Energy Act may be released without clearance according to § 29 of the Radiation Protection Ordinance if they do not come from the controlled area and are not contaminated or activated. A soil area may also be released (removed) from nuclear supervision without clearance according to § 29 of the Radiation Protection Ordinance if its contamination is excluded. The general proceeding for this kind of release (removal) is to be described in a licensing document.

The starting point for the safety assessment for decommissioning measures is the potential hazard which is determined by the inventory of radioactive substances, the technical condition of the facility and its design from the point of view of safety. The applicable design requirements for construction and operation cannot be unconditionally used for the safety assessment of decommissioning measures. Based on the respective condition of the shut down facility, the safety assessment of the planned measures must be oriented towards the values of §§ 46, 47, 50 of the Radiation Protection Ordinance and all other protective requirements of the Radiation Protection Ordinance. For accident considerations it is necessary to assume the sequences of events which derive from the type, quantity and distribution of remaining radioactive substances together with the decommissioning activities which are the subject of the application.

As long as there is still nuclear fuel in the facility during the decommissioning procedure exceeding the masses or concentrations mentioned in § 2, para. 3 of the Atomic Energy Act, the requirements that are necessary to guarantee safety must continue to be fulfilled.

If the radioactive waste from decommissioning is intended for storage at the site of the facility decommissioned or being dismantled, § 7, para. 1 of the Radiation Protection Ordinance comes into consideration as legal basis for licensing of construction and operation of the storage facility. However, the coverage of storage by the decommissioning license pursuant to § 7, para. 3 of the Atomic Energy Act, which may be an alternative according to § 7, para. 2 of the Radiation Protection Ordinance, is only possible until the end of decommissioning or termination of dismantling of the facility. If also radioactive wastes of third parties are treated within the framework of decommissioning and dismantling of the facility, a separate license is required according to § 7, para. 1 of the Radiation Protection Ordinance.

## **2.2 Legal regulations**

The legal bases for decommissioning procedures are the Atomic Energy Act and the associated legal ordinances and general administrative provisions. There exist no other laws and regulations specific to the decommissioning procedure. Even the technical rules primarily deal with the construction and operation of nuclear facilities.

The regulations which are of particular importance for decommissioning projects are outlined briefly below and are listed in the Handbook on Nuclear Safety and Radiation Protection /6/.

### **Atomic Energy Act (AtG)**

Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards (Atomic Energy Act) of 23 December 1959, as amended and promulgated on 15 July 1985 (Federal Law Gazette (BGBl.) I, page 1565), last amendment by Article 1 of the Act of 17 March 2009 (Federal Law Gazette (BGBl.) I, page 556)

In § 7, para. 3, the Atomic Energy Act includes the basic provision for licensing of the decommissioning of nuclear facilities and the safe enclosure or dismantling of the facility or parts thereof. At the

same time it is the only provision of the Atomic Energy Act which relates specifically to decommissioning for facilities as defined in § 7, para. 1 of the Atomic Energy Act.

The basic provisions of § 9a of the Atomic Energy Act apply for the utilisation of radioactive residues and for radioactive components which have been dismantled or removed and the disposal of radioactive wastes.

§ 2a of the Atomic Energy Act describes the role of the environmental impact assessment within the nuclear licensing procedure and defines general rules for its performance.

### **Act on the Environmental Impact Assessment (UVPG)**

Act on the Environmental Impact Assessment of 12 February 1990 (Federal Law Gazette (BGBl.) I, page 205), as amended and promulgated on 25 June 2005 (Federal Law Gazette (BGBl.) I, page 1757), amended on 9 September 2005 (Federal Law Gazette (BGBl.) I, page 2797), last amendment by Article 1 of the Act of 22 December 2008 (Federal Law Gazette (BGBl.) I, page 2986)

Appendix 1, no. 11 of the Act on the Environmental Impact Assessment specifies for which nuclear facilities it is mandatory to conduct an environmental impact assessment (EIA – German abbreviation: UVP).

### **Nuclear Licensing Procedure Ordinance (AtVfV)**

Ordinance on the Procedure for Licensing of Installations under § 7 of the Atomic Energy Act (Nuclear Licensing Procedure Ordinance) of 18 February 1977, as amended and promulgated on 3 February 1995 (Federal Law Gazette (BGBl.) I, page 180), last amendment by Article 4 of the Act of 9 December 2006 (Federal Law Gazette (BGBl.) I, page 2819)

The licensing procedure for decommissioning, safe enclosure and dismantling of nuclear facilities or parts of facilities according to § 7 of the Atomic Energy Act is based on the Nuclear Licensing Procedures Ordinance. It contains provisions which are specific to decommissioning, in particular for the involvement of third parties and for the environmental impact assessment in § 4, para. 4 and § 19b of the AtVfV.

In order to check the other provisions that are subject to public law related to the project, reference is made to § 14 of the AtVfV and for projects that are subject to an environmental impact assessment also to § 14a of the AtVfV.

Other regulations in the AtVfV which are relevant here relate to the documents which must be submitted for radioactive residues (§ 3, para. 1 subpara. 8 of the AtVfV).

### **Radiation Protection Ordinance (StrlSchV)**

Ordinance on the Protection against Damage and Injuries Caused by Ionizing Radiation (Radiation Protection Ordinance) of 20 July 2001 (Federal Law Gazette (BGBl.) I, page 1714), last amendment by Article 2 of the Act of 29 August 2008 (Federal Law Gazette (BGBl.) I, page 1793)

The Radiation Protection Ordinance is of particular relevance for the decommissioning measures. Its provisions contained in § 2, para. 1, subpara. 1 (c) apply to decommissioning, safe enclosure of a facility and the dismantling of a facility or parts of a facility as defined in § 7 of the Atomic Energy Act, and therefore it determines to a large extent the technical and operational measures, procedures and precautions for protection against damage from ionising radiation. In particular § 29 of the Radiation Protection Ordinance regulates the clearance unless existing regulations are maintained according to the transitional provisions of § 117, para. 10 of the Radiation Protection Ordinance.

### **Nuclear Financial Security Ordinance (AtDeckV)**

Ordinance Concerning the Financial Security Pursuant to the Atomic Energy Act (Nuclear Financial Security Ordinance) of 25 January 1977 (Federal Law Gazette (BGBl.) I, page 220), last amendment by Article 9, para. 12 of the Act of 23 November 2007 (Federal Law Gazette (BGBl.) I, page 2631).

§ 12 of the Nuclear Financial Security Ordinance represents a specific provision for decommissioning. If there are no more fuels in the facility, Annex 2 Column 3 applies. In conjunction with Annex 2 of the Nuclear Financial Security Ordinance, the standard limit can be specified by means of the residual activity in the facility as multiple of the exemption values defined in Appendix III Table 1 Column 2 of the Radiation Protection Ordinance.

### **Other nuclear ordinances**

Other nuclear ordinances which are also applicable in the decommissioning procedure are

- Cost Ordinance under the Atomic Energy Act (AtKostV)

Cost Ordinance under the Atomic Energy Act of 17 December 1981 (Federal Law Gazette (BGBl.) I, page 1457), last amendment by Article 4 of the Act of 29 August 2008 (Federal Law Gazette (BGBl.) I, page 1793)

- **Nuclear Safety Officer and Reporting Ordinance (AtSMV)**  
Ordinance on the Nuclear Safety Officer and the Reporting of Accidents and other Events (Nuclear Safety Officer and Reporting Ordinance) of 14 October 1992 (Federal Law Gazette (BGBl.) I, page 1766), last amendment by Ordinance of 18 June 2002 (Federal Law Gazette (BGBl.) I, page 1869)
- **Nuclear Reliability Verification Ordinance (AtZüV)**  
Ordinance on the verification of reliability of persons as a protection against a diversion or major release of radioactive material according to the Atomic Energy Act (Nuclear Reliability Verification Ordinance) of 1 July 1999 (Federal Law Gazette (BGBl.) I, page 1525), last amendment by Act of 11 October 2002 (BGBl.) I, page 3970)
- **Reference is made to the Repository Prepayment Ordinance (Endlager-VIV)**  
Ordinance Concerning Prepayments for the Erection of Federal Facilities for the Long-Term Engineered Storage and Disposal of Radioactive Waste (Repository Prepayment Ordinance) of 28 April 1982 (Federal Law Gazette (BGBl. I), page 562), last amendment by Ordinance of 6 July 2004 (Federal Law Gazette (BGBl. I), page 1476).

### **2.3 Technical rules**

The technical rules which exist for nuclear facilities such as

- announcements (criteria, principles, guidelines, recommendations) of the Federal Ministry of the Interior (BMI) and of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU),
- standards of the Nuclear Safety Standards Commission (KTA),
- technical standards,
- recommendations of the Nuclear Waste Management Commission (ESK), the Reactor Safety Commission (RSK) and the Commission on Radiological Protection (SSK)

were primarily created for the construction and operation of these facilities.

#### **Announcements of the BMI/BMU and KTA standards**

The BMI/BMU announcements and the KTA standards were assessed for their applicability to the decommissioning of nuclear facilities and were divided into the following three categories:

Category 1: The rule is generally applicable and must therefore be taken into account in the decommissioning procedure.

Category 2: The rule is not relevant to decommissioning procedures. However, in case of construction measures that might be performed within the framework of decommissioning or significant changes of use it can be applied adapted to protection objectives in terms of Category 3.

Category 3: The rule is applicable after adaptation to the protection objectives or is partially applicable to decommissioning procedures, taking account of the changed, in many respects reduced, potential hazard and the modified requirements relative to construction and operation.

In Annex 2, the rules are assigned to the different categories. The listing given in the Handbook on Nuclear Safety and Radiation Protection /6/ was used.

Annex 3 contains comments on adaptation of the regulations to the protection objectives or the partial application of the rules assigned to Category 3.

Where there are no special nuclear safety requirements or radiation protection requirements, the general technical standards can be applied instead of the KTA standards.

### **Technical standards**

There are only few standards which are explicitly applicable to decommissioning, safe enclosure and dismantling of nuclear facilities. The DIN standards which are specific to nuclear technology cover various areas of nuclear technology such as: basic requirements, terms and symbols; construction, operation and inspection of individual components or whole systems; radiological measurement technology, dosimetry: measuring techniques for contamination, discharges and for the clearance of radioactive substances; operation of equipment etc. These standards are to be applied, as far as applicable to facilities to be decommissioned. Deviations from the technical standards may be allowed in individual cases if the necessary level of safety can be guaranteed to a comparable degree in another way.

### **Recommendations of the Reactor Safety Commission (RSK)**

General recommendations on decommissioning procedures of nuclear facilities are presently not available. Statements given refer to actual decommissioning procedures.

The RSK recommendation titled "Safety requirements on the storage of low and intermediate level waste in the longer term" /14/ is also of relevance for the decommissioning of nuclear facilities.

## **Recommendations of the Commission on Radiological Protection (SSK)**

General recommendations on decommissioning procedures of nuclear facilities are presently not available. Statements given refer to actual decommissioning procedures. The recommendations made on general or plant-specific issues of radiation protection are also to be considered in the decommissioning procedure.

Before amendment of the Radiation Protection Ordinance (StrlSchV), the SSK recommendations of 12.02.1998 on the clearance of materials, buildings and sites with negligible radioactivity from practices subject to reporting and licensing /7/ were of particular relevance for the decommissioning measures. After comprehensive regulation of clearance in the amendment of the Radiation Protection Ordinance of 20.07.2001, the provisions of the Radiation Protection Ordinance are now binding. Where licenses already granted refer to decommissioning, safe enclosure of the dismantling of facilities or parts of facilities, the clearance regulation contained in these licenses will continue to apply for an unlimited period of time according to the transitional provisions of § 117, para. 10 of the Radiation Protection Ordinance. In these cases, the SSK recommendations can still be relevant.

## **Recommendations of the Nuclear Waste Management Commission (ESK)**

General recommendations on decommissioning procedures of nuclear facilities are presently not available. Statements given refer to actual decommissioning procedures.

## **2.4 International regulations, standards and recommendations**

The Handbook on Nuclear Safety and Radiation Protection /6/ lists multilateral agreements, legal provision of the European Union and safety standards of the IAEA that may also serve as orientation for decommissioning. Among these are, in particular:

## **Euratom Treaty**

Article 37 of the Euratom Treaty requires that for any plan for the disposal of in whatever form radioactive material “general data” from which potential impacts on the territory of other states of the European Union can be determined, shall be submitted to the European Commission.

Annex 2 of the Commission Recommendation of 6 December 1999 on the application of Article 37 stipulates that for the dismantling of nuclear reactors and reprocessing plants general data shall be given on the site and its surrounding, on the installation, on the release of airborne radioactive effluents in normal condition, on the release of liquid radioactive effluents in normal conditions, on the disposal from the installation of solid radioactive waste (also including the specified clearance levels, material types and amounts), on unplanned releases of radioactive effluents, on emergency plans and, finally, on environmental monitoring.

The data must be notified to the Commission via the competent Federal Ministry, if possible one year before, but at least six months before, the competent licensing authority issues a license for the discharge of radioactive substances.

## **Convention on spent fuel and nuclear waste management**

The convention on spent fuel and nuclear waste management (Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management) adopted on 5 September 1997 in Vienna is not directly binding for the licensing and supervisory authority or the applicant. However, it must be implemented by the Federal Republic of Germany nationally /16/. The convention also extends to the decommissioning, the safe enclosure and the dismantling of nuclear facilities. Article 26 (Decommissioning) of the convention is the central provision to decommissioning with references to other articles relevant in this context, such as Article 22 (Human and financial resources), Article 24 (Operational radiation protection) and Article 25 (Emergency preparedness). Further, Article 26 (Decommissioning) mentions the obligation to record and keep information important to decommissioning. In addition to the more stringent obligations of Article 26 (decommissioning), further requirements are relevant for decommissioning.

## **Safety standards of the IAEA**

The Federal Republic of Germany acknowledges the internationally accepted safety principles as specified, for example, in the "Safety Fundamentals" of the IAEA and implements them, where required, in national law. The following IAEA safety standards are relevant for decommissioning:

- Safety Fundamentals on the Principles of Radioactive Waste Management /4/,
- Safety Requirements on Predisposal Management of Radioactive Waste Including Decommissioning /5/,
- Safety Guide on Decommissioning of Nuclear Fuel Cycle Facilities /1/,
- Safety Guide on Decommissioning of Nuclear Power and Research Reactors /2/,
- Safety Guide on Decommissioning of Medical, Industrial and Research Facilities /3/,
- Safety Requirements on Decommissioning of Facilities Using Radioactive Material /17/,
- Safety Guide on Release of Sites from Regulatory Control on Termination of Practices /18/,
- Safety Guide on Storage of Radioactive Waste /19/.

### **3. Decommissioning planning and application documents**

The approaches which are described below for planning and compilation of application documents have been developed from experience so far gained in order to promote a uniform practice for future decommissioning procedures under nuclear legislation.

A general decision in planning of decommissioning is the choice of the decommissioning strategy, i.e. which of the two options – direct dismantling or safe enclosure – shall be realised. The term decommissioning concept is understood as the conceptual approach to decommissioning that is already available during construction and operation of the facility. This decommissioning concept is continued to be developed parallel to the operation of the facility so that at the time of first application for decommissioning a decommissioning plan in terms of § 19b, para. 1 of the AtVfV can be submitted.

According to § 7, para. 3 of the Atomic Energy Act, the decommissioning of a facility pursuant to § 7, para. 1 of the Atomic Energy Act, the safe enclosure of the finally decommissioned facility and the dismantling of the facility or parts of a facility require licensing without further delimitation of the conditions for licensing. In the licensing practice so far, the necessary licenses were granted on a step-wise basis. Within the framework of the procedure for the first license, all of the measures planned for decommissioning and the implementation of the measures in the procedure are to be dealt with and to be assessed under the aspect whether measures applied for in the first license do not hamper or prevent further measures, and whether an appropriate order of the dismantling measures is provided (§ 19b, para. 1 of the AtVfV). At the same time, an environmental impact assessment of the entire decommissioning project is to be carried out for the first license (§ 19b, para. 3 of the AtVfV).

For facilities to be decommissioned, the existing safety management is to be adapted to the changed potential hazard and the requirements of decommissioning.

#### **3.1 Decommissioning strategies**

According to § 7, para. 3 of the Atomic Energy, the following decommissioning strategies are available in Germany:

- Dismantling ...  
immediate dismantling of the facility or parts thereof from nuclear regulatory supervision
- Safe enclosure ...  
postponement of final dismantling to a later period while the facility is placed into a safe storage on site.

Decommissioning strategies may also be a combination of these fundamental alternatives.

The permanent on-site-storage (so-called entombment) is discussed internationally but excluded for Germany.

The Atomic Energy Act and the German legal regulations consider the decommissioning strategies “immediate dismantling” and “safe enclosure” to be equivalent. For the decision of the operator which decommissioning strategy shall be applied, among others, the following factors may play a role /2/:

- provisions of compliance with laws, regulations and standards which should be applied during decommissioning,
- characteristics of the of the facility, operating history as well as radiological inventory immediately after final shutdown and how this changes with time,
- safety assessment of the radiological and non-radiological hazards,
- radioactive waste management including their storage and disposal,
- the physical status of the facility and its evolution for the duration of decommissioning,
- adequacy and availability of financial resources,
- availability of experienced personnel and proven techniques,
- lessons learned from previous decommissioning projects,
- the environmental and socioeconomic impact, including public concerns about the decommissioning activities, and
- the planned use of the site or facility (parts of the facility) after completion of decommissioning.

The principle of safe enclosure is based on the fact that the activity present at a certain time continually reduces as time goes on ("decay" of activity). To this aim, the activity inventory remaining in the facility is fixed or contained for an extended period of time and secured against unauthorised access after removal of the nuclear fuel. For safe enclosure it is to be verified that after termination of safe enclosure it will still be possible to assess the radiological situation by measurements with reasonable effort.

One aim of safe enclosure is therefore to let the activity inventory decay so that subsequent dismantling work can be done with reduced local dose rate and possibly with simpler techniques.

For safe enclosure, the expenditure on staffing, maintenance and surveillance depends upon the potential hazard, the existing activity barriers and the maintenance measures which are necessary.

The decommissioning license has to specify type and scope of the safety reviews for the plant to be conducted during safe enclosure at regular intervals.

At the international level, it is clearly recognisable that preference is given to immediate dismantling /15/. This preference is based on the experiences made, in particular with regard to the availability of personnel from the operating phase familiar with the operating history, the mitigation of economic effects of decommissioning in the region and security of funding. In Germany, immediate dismantling is mainly practised so far.

A special variant of immediate dismantling, by which it is also possible to use the advantages of safe enclosure, is the removal of complete large components from the plant without segmentation, the storage of these components and their later segmentation. Thereby not only the decommissioning process is optimised but – like in the case for safe enclosure – the activity inventory decays as far that the following disassembly work can be performed with reduced local dose rate and possibly with simpler techniques.

### **3.2 Decommissioning concept**

Regarding the preparation of decommissioning, Criterion 2.10 is laid down in the BMI Safety Criteria for Nuclear Power Plants /8/ as follows:

“Criterion 2.10: Decommissioning and disposal of nuclear power plants

Nuclear power plants must be designed in such a way that they can be decommissioned in compliance with radiation protection provisions. There must be a concept for disposal after final decommissioning in compliance with the radiation protection conditions.“

Equivalent requirements are laid down in no. 2.15 of the safety requirements for nuclear fuel supply facilities of April 1997.

This requires the problem of decommissioning and disposal to be considered well in advance of the end of operation.

As a rule, the operating licenses for nuclear power plants stipulate a periodic review of the decommissioning plan. Important aspects of this are the technical documentation of the facility, its systems, components, buildings and materials and data relevant to radiation protection (dose rate atlas and contamination atlas) and the consequences of special events which are relevant for the decommissioning procedure.

In addition, all maintenance precautions, as also mentioned under Criterion 2.4 in the BMI Safety Criteria /8/, can be used for planning the decommissioning measures.

The decommissioning concept is further developed parallel to the operation of the facility so that at the time of first application for decommissioning a decommissioning planning can be submitted in terms of § 19 b, para. 1 of the AtVfV.

### **3.3 Application documents**

According to § 3, para. 1 of the AtVfV, all of the documents which are necessary to check the preconditions for approval as defined in § 7, para. 2 of the Atomic Energy Act must be attached to the application for the issue of a license under the terms of § 7, para. 3 of the Atomic Energy Act.

According to § 19b, para. 1 of the AtVfV, the first application also has to provide information about all measures planned for decommissioning, for safe enclosure or for the dismantling of facilities or parts of facilities. This should outline in what application and licensing steps the decommissioning procedure should take place, taking into account the licensing situation defined in § 7, para. 3 of the Atomic Energy Act. This information should provide a basis for assessing, in particular, if other measures are hampered or prevented and whether the dismantling measures are planned in an appropriate order also from the point of view of radiation protection. According to § 19b, para. 3 of the AtVfV, in the case of first application, the EIA extends to all measures planned on decommissioning, safe enclosure or dismantling of the facility or parts thereof (cf. Section 4.4).

This means for the decommissioning of nuclear facilities that, regarding the technical content of the application documents, the following details are particularly required:

- a) Description of the facility, the site and the surrounding area as well as the operating history of the facility, insofar as it is relevant for decommissioning, and possibly a preview of the subsequent use of the site,
- b) Legal provisions, technical rules and other provisions which have been taken into account for decommissioning,
- c) Description of the measures for decommissioning applied for and of the entire decommissioning procedure planned as well as the demonstration that later dismantling will not be hampered by the measures applied,
- d) Description of the planned decommissioning and dismantling techniques such as decontamination methods, cutting techniques and remotely controlled dismantling techniques
- e) Description of new systems or systems which are to be modified,
- f) Safety studies including accident analyses, taking into account the provisions of § 50 of the Radiation Protection Ordinance for the planned decommissioning activities and the operation of new or modified systems and with a view to fulfilling the minimisation requirement in § 6, para. 2 of the Radiation Protection Ordinance and other radiation protection principles and radiation protection provisions for workers, the environment and the population. It must be demonstrated how the necessary provisions against damage are guaranteed.
- g) Estimation and evaluation of the radioactive inventory and, where applicable, of dangerous substances and proofs of this,
- h) Description and classification of the radioactive wastes which arise, their conditioning, storage and disposal as well as the measures for radioactive waste reduction,
- i) Description of the clearance procedure for radioactive substances and their utilisation as well as the description of the removal procedure,
- j) Description of the radioactive discharges with exhaust air and effluent, application values for discharges and radiological exposure calculated therefrom,
- k) Programme for environmental monitoring,
- l) Measures for protection of workers, fire protection and radiation protection during performance of the decommissioning measures including the construction of new facilities or the modification of existing ones,
- m) Description of the operational organisation and responsibilities for decommissioning, proofs of the technical qualification of the personnel responsible and the preservation of technical qualification and necessary know-how of other persons involved,

- n) Description of accompanying controls (quality assurance) and their performance (e.g. by means of work schedules),
- o) Description of the clearance procedure for the site and the removal procedure,
- p) Planned reporting to the supervisory authorities,
- q) Description of physical protection measures,
- r) Data and information on other environmental impacts of the decommissioning project,
- s) Planned procedure for the permission to perform a dismantling step (e.g. dismantling step procedure).

For projects requiring an EIA (e.g. first application for decommissioning), the application has to include, in addition to the report on the environmental impact studies, the following documents (§ 3, para. 2 of the AtVfV):

- t) A survey of the most important alternative technological processes examined by the applicant, including a statement of the major reasons for the selection of a procedure,
- u) references to difficulties which arose when the data for the environmental impact assessment were collected.

Where a state of safe enclosure is brought about, corresponding statements are to be made in the application documents both for the safe enclosure phase and also for the phase during which this is being achieved.

In addition, the following should be submitted for the safe enclosure:

- aa) The description of the physical-technical state of the facility in safe enclosure,
- bb) The planned monitoring and maintenance programme,
- cc) The description of existing or new systems for maintaining the safe enclosure, e.g. barriers, ventilation, condensate removal, instrumented monitoring.

### **3.4 Safety considerations**

The potential hazard of a decommissioned nuclear facility depends almost exclusively upon its activity inventory and the possibilities of a release of radionuclides associated with decommissioning. Unlike during the operation of the facility, there is practically no energy potential resulting from criticality and decay of radioactive substances or inherent in the pressure and temperature conditions of the operating media.

In the case of facilities for the fissioning of nuclear fuels, removal of the fuel elements alone brings about a considerable reduction in the activity inventory. The possibility of criticality is then excluded. Activation activity is safely contained in the activated components themselves. The contamination which is present in the facility and the activation activity which could be converted into a releasable form by the dismantling activities are therefore the relevant issues for accident considerations relating to decommissioning activities.

The radioactive inventory of nuclear fuel cycle facilities is very different from that of reactor facilities. There is no activation activity. The most significant potential hazard in nuclear fuel cycle facilities is the radioactive material in dispersible form and the possibility of a criticality as long as there is still fissile material in the facility. Removal of the nuclear fuel from the facilities reduces the potential hazard significantly. The alpha-emitters which remain in the facilities result in radiological exposures following intake which are predominant in the facility for the workers and in the event of releases for the general public.

For decommissioning procedures pursuant to § 7, para. 3 of the Atomic Energy Act, structural or technical protective measures shall be undertaken, under consideration of the potential damage extent, in order to limit radiation exposure in the event of design-basis accidents, as defined in § 50, para. 2 in conjunction with para. 1 of the Radiation Protection Ordinance. The licensing authority determines the type and scope of the protective measures, taking into consideration the individual case, particularly the potential hazard of the facility and the probability of the occurrence of a design-basis accident. According to § 50, para. 4 of the Radiation Protection Ordinance, the protection objectives for accident precautions shall be specified by general administrative provisions. Until their entry into force, a design-basis accident planning value of 50 mSv is applicable for the effective dose as defined in § 117, para. 18 of the Radiation Protection Ordinance. Some of the safety considerations (design-basis-accident analyses) already made for the construction and operation of the decommissioned facility can continue to be used. During the decommissioning procedure, as long

as there is still nuclear fuel in the facility exceeding the masses or concentrations mentioned in § 2, para. 3 of the Atomic Energy Act, all of the necessary safety precautions must continue to be observed and must be included in the corresponding considerations.

Many decommissioning activities, particularly those involving the dismantling of parts of facilities, involve very similar techniques to those of the maintenance procedures and modification measures already licensed for operation. In this respect, special safety considerations or design-basis-accident analyses are only required if the status of the facility is altered, for the dismantling of components, for new systems which are to be erected or systems which are to be modified and for new technical processes. Relevant for kind and scope of the necessary precautions against damage are the criteria resulting according to the state of the art in science and technology for the reduced potential hazard of a nuclear facility under decommissioning.

The following events are to be considered and evaluated from the point of view of safety in decommissioning projects on a case-related basis:

- Fire in the facility,
- Leakage from vessels or systems,
- Drop of loads,
- Failure of supply systems,
- Criticality accident,
- Penetration of water into the safe enclosure,
- External impacts (e.g. earthquakes, storms, floods, penetration of gases).

Apart from the radiological loads, hazards may arise from mineral wool and asbestos as well as from chemicals (residues from plant operation, decontaminating agents) which are present in the facility or which are used for decommissioning purposes.

The barrier system present during operation of the facility to prevent the escape of radioactive substances into the facility or into the environment is modified during the decommissioning work. For example, in nuclear power plants, the core internals and primary circuit are thermally or mechanically disassembled during the course of dismantling work. In this respect, it may become necessary during the decommissioning procedure to set up barrier systems in form of local housings or buildings with stationary / mobile ventilation and filter systems.

Nearly all of the accidents within the plant can be assigned to the "basic types" *fire, leakage from vessels containing radioactive fluid and drop of loads*. As a rule, the design-basis accident *fire in the facility* is radiologically representative of these "basic types", in particular if the filter system should fail as a consequence of the fire.

### **3.5 Definition of decontamination and dismantling techniques**

These techniques include all processes for the decontamination of systems, components and buildings as well as separation, cutting and demolition techniques.

The nature and extent of decontamination work which needs to be carried out depends upon the type of facility (different radioactive substances, degree of contamination), upon the kind of clearance and removal of the radioactive substance and upon the aim of decommissioning.

The decontamination methods are chosen with the following aspects in mind:

a) Aspect of radiation protection

- Avoidance of unnecessary radiation exposure,
- dose reduction,
- removal of contamination to increase the admissible time individuals can spend in the working areas or to achieve appropriate conditions for carrying out decommissioning work.

b) Aspect of utilisation of radioactive substances

- The greatest possible non-detrimental utilisation of radioactive substances or plant components,
- reduction in the volume of radioactive substances to be stored in storage facilities until disposal,
- minimisation of secondary waste generated during decontamination and dismantling.

c) Other aspects

- Where required, establishment of boundary conditions for another use of the facility or the site.

Regarding the dismantling techniques, a distinction is to be made between the usual conventional methods including the maintenance techniques used during operation on the one hand, and remote

techniques together with the associated radiation protection and accident prevention measures on the other hand.

The choice of dismantling techniques depends upon:

- a) the technological task (material, size of component, environmental conditions, accessibility),
- b) the radiation protection conditions (type and amount of activity present, possibility of aerosol formation, contamination hazard, containment of mobile activity and measures for limiting the individual and collective dose),
- c) the intended further treatment and utilisation of substances, the conventional disposal of wastes and the disposal of radioactive wastes,
- d) the secondary waste generated.

Today, there are a large number of tried and tested technologies available for decontamination and disassembly of facilities or parts of facilities. The operational safety, the emission behaviour and applicable measures for radiation protection of workers as well as costs for it are known.

As far as the licensing procedure is concerned, it is therefore sufficient to describe these tried and tested methods adequately from a safety point of view and to establish the boundary conditions for their use.

Which decontamination and dismantling techniques are applied for the dose-relevant disassembly, i.e. for such requiring a special radiation protection procedure according to IVRS guideline Part II /13/, is specified in the detailed planning and accompanied by regulatory supervision. If an application is made to use procedures which have not been proven and which are of essential relevance for the decommissioning project, the general feasibility of the respective dismantling step is to be demonstrated in the context of the licensing procedure and it is to be specified in which way the definite proof of suitability can be furnished within the supervisory procedure. This confirmatory proof of suitability is to be furnished before use of such procedure.

It is necessary to use special manipulators and devices for the remote disassembly techniques which are required for some cases. Where the operational reliability of this equipment cannot be immediately assumed and also where specific characteristics of the facility must be taken into account, proof of suitability (preliminary tests, acceptance and functional tests, in-service inspections, safety analyses) must be provided for this equipment. In this case, the principle proceeding of the

disassembly sequence must already be submitted with the application documents. Where appropriate, preliminary tests may be done on test rigs to optimise the individual disassembly sequences.

### **3.6 Staffing provisions**

The requirements for staffing provisions are both applicable to internal and external personnel. The applicant/operator must ensure that an adequate number of appropriate staff with the required qualification and knowledge is available in all phases and periods of the decommissioning procedure until release from nuclear supervision. The use of internal personnel as responsible persons in terms of the technical qualification guideline has proved itself regarding continuity of staff. In accordance with the terms of § 7, para. 2 subpara. 1 of the Atomic Energy Act, the persons who are responsible must have the necessary technical qualification and the organisational structures which are necessary to guarantee the safety requirements must be in place. Other individuals involved in the decommissioning measures must possess the necessary knowledge defined in § 7, para. 2 subpara. 2 of the Atomic Energy Act. In addition, it must be ensured that in all cases of personnel changes, even in the event of a possible change in licensee, all of the documentation relating to the actual status of the facility is completely transferred and retained so that no significant knowledge about the facility will get lost. The applicant/operator must submit appropriate evidence on the staffing provisions.

Regarding the reliability of the internal and the external personnel, the regulations of the Nuclear Reliability Verification Ordinance (AtZüV) apply.

### **3.7 Financial security**

In § 12 of the Nuclear Financial Security Ordinance (AtDeckV), the establishment of insurance sums for the decommissioning or other shutting down of a facility is permitted depending on the activity remaining in the decommissioned facility whereby, in order to establish the regulatory insurance sums, an evaluation is made of the activity in relation to the multiple exemption values defined in Appendix III Table 1 Column 2 of the Radiation Protection Ordinance.

A condition for application of § 12 of the AtDeckV is that only the activated and contaminated parts as well as radioactive substances, if any, remain in the facility for the purpose of inspection. Where, because of the peculiarities of an individual case, it is not possible to determine the level of activity or if this can only be done at great expense, the administrative authority can reduce the insurance sum down to 5 % of the insurance sum last established before decommissioning or other shutting down of the facility.

In individual cases – in particular if there is still nuclear fuel in the facility – the corresponding regulations of the AtDeckV are to be observed.

The licensee must provide corresponding proofs of the insurance provisions which have been made.

## **4. Licensing procedure**

The permissions and conditions of a license for decommissioning, safe enclosure or dismantling of facilities as defined in § 7, para. 3 of the Atomic Energy Act are specified on the basis of the license application by appropriate application of § 7, para. 2 of the Atomic Energy Act.

Depending upon the type of application, the decommissioning measures for nuclear facilities can be regulated by a single license but can also be divided into steps which are licensed separately with their own licenses as defined in § 7, para. 3 of the Atomic Energy Act. In the procedures which have taken place so far it has proven itself for large projects, such as the dismantling of nuclear power plants or nuclear fuel cycle facilities, to divide the decommissioning procedure into technically delimited steps. A comprehensive decommissioning license may be advantageous for smaller projects e.g. for research reactors, hot cells or possibly for bringing about a state of safe enclosure.

### **4.1 Checking the preconditions for licensing**

The license may only be issued if the pre-conditions for licensing defined in § 7, para. 3 in conjunction with para. 2 of the Atomic Energy Act, to be applied as appropriate, are fulfilled or if their fulfilment can be guaranteed by ancillary conditions (§ 15, para. 2 sentence 1 of the AtVfV) and the other public legislation requirements have been observed (§ 14 of the AtVfV). Completeness of the application documents as defined in § 3 of the AtVfV and their assignment to the licensing preconditions can be checked using the list given in Annex 4. In addition, Annex 4 refers to documents of other legal provisions which, because of the concentration effect of the nuclear license (§ 8, para. 2 Atomic Energy Act) must be checked or considered in the nuclear licensing procedure according to § 14 of the AtVfV.

### **4.2 Transition from operating license to decommissioning license**

After operation of a facility has finally ceased, those activities can be carried out in the post-operational phase which are covered by the operating license and which are essentially a component part of operating practice. As a rule, these include:

- unloading of fuel elements of nuclear fuels,

- utilisation of radioactive substances and disposal of radioactive wastes from the operational phase,
- sampling of systems and components required for application,
- decontamination of the facility and systems.

Other waste management measures, for example those relating to wastes which cannot be routinely disposed of, may come under the phase which follows the issue of the decommissioning license.

The required availability of systems in the post-operational phase is based on the regulations in the operating manual (BHB) for the outage of the nuclear facility. The operator retains the right to apply for further adaptations to longer-term outages, taking particular account of the related nuclear hazard. Simplifications in the area of safety specifications (SSP), e.g. availability of systems or reduction of in-service inspections, are also possible. Under certain circumstances measures, the post-operational phase may already include preparations for the safe enclosure or for removal of the facility, in so far as these are covered by the operating license or do not represent significant changes (i.e., they can be carried out in accordance with the operating manual as insignificant changes).

Where there is no operating license or this has expired, the competent authority must establish the technical conditions and regulations for guaranteeing safety in the post-operational phase.

If the operating license is suspended on issue of the decommissioning license, then conditions and regulations of the operating license which continue to be applicable must be incorporated in the decommissioning license.

If the operating license is not completely suspended on issue of the decommissioning license, then the unaltered conditions and regulations of the operating license remain in force. The conditions and regulations remaining in force are then to be specified in the decommissioning license.

### **4.3 Licensing procedure with several steps**

In this type of licensing procedure the decommissioning procedure is divided up into individual steps which are applied for and licensed separately. Decommissioning, safe enclosure, dismantling of the

plant and dismantling of plant components constitute separate licensing contents as defined in § 7, para. 3 of the Atomic Energy Act.

According to § 19b, para. 1 of the AtVfV, the documents to be enclosed with the first application for a license pursuant to § 7, para. 3 of the Atomic Energy Act shall also include specifications on all measures planned on decommissioning, on safe enclosure or on dismantling. This information should make it possible to assess whether the measures applied for do not hamper or prevent further measures and whether provision is made for an appropriate order of dismantling activities. This assessment, however, does not constitute a preliminary positive overall assessment with a corresponding linking function as it is required according to § 18, para. 1 of the AtVfV for granting of partial licenses for construction and operation.

Also in case of fundamental change of the overall concept, if for example instead of safe enclosure immediate dismantling is chosen, the license application must include documents enabling an assessment of the overall concept with regard to feasibility and plausibility as well as of compatibility and logical sequence of the steps.

Dividing up the decommissioning sequence means that new techniques can be introduced and experience which has been gained in the previously completed phases can be applied. Assessment of the next step can also take place in parallel to execution of the phase which has already been licensed. In certain circumstances these can also result in a time saving on the overall project.

With the separate licenses defined in § 7, para. 3 of the Atomic Energy Act it is possible to establish conditions according to which plant components or ancillary installations which are no longer required in the decommissioning procedure for achieving the purposes outlined in § 1 of the Atomic Energy Act and which might be used elsewhere are released from nuclear supervision and thus the scope of the facility and also the limits of the controlled and supervised area under the terms of the Radiation Protection Ordinance might be redefined.

This means that those parts of the facility which are not required for safety purposes (buildings, systems, components) which are not necessary for fulfilling the protection objectives defined in § 1 of the Atomic Energy Act and safe occupancy of the facility (e.g. "inactive parts of the plant") can only be dismantled and disposed of on receipt of a corresponding license in so far as they are included in the scope of the plant according to § 7, para. 1 of the Atomic Energy Act.

Depending on the requirements, buildings that remain after dismantling of systems and components can be removed from government custody or cleared for unrestricted use according to § 29 of the Radiation Protection Ordinance . Buildings of a controlled area are always subject to clearance according to § 29 of the Radiation Protection Ordinance for release from nuclear supervision.

#### **4.4 Environmental impact assessment and involvement of third parties**

According to the Act on the Environmental Impact Assessment (UVPG), Appendix 1, no. 1, an environmental impact assessment must be carried out for decommissioning, safe enclosure or the dismantling of stationary facilities for fission of nuclear fuels exceeding 1 kW continuous thermal load.

Notwithstanding § 4, para 4 of the AtVfV, § 19b, para. 2 of the AtVfV also stipulates that an announcement and disclosure of the project for public inspection cannot be waived if for such facilities a first application for decommissioning as defined in § 7, para. 3 of the Atomic Energy Act is filed. According to § 19b, para. 1 of the AtVfV, the application documents shall, in particular, to judge whether the measures applied for do not hamper or prevent further measures, and whether an appropriate order of the dismantling measures is provided. According to § 19b, para. 3 of the AtVfV, the environmental impact assessment then extends to all measures planned for decommissioning, safe enclosure or dismantling of the facility or parts of a facility. For this purpose, the documents specified in § 6, para. 1 and para. 2 of the AtVfV have to be disclosed for public inspection.

Further applications on individual measures for decommissioning or safe enclosure or dismantling of the entire facility or individual parts of a facility to be licensed under nuclear legislation require a preliminary assessment of the individual case according to § 3e, para. 1 subpara. 2 in conjunction with § 3c of the UVPG (cf. no. 11.1 of Appendix 1 to the UVPG).

In the preliminary assessment by the licensing authority, consideration must be given to criteria such as the remaining radioactive inventory (sometimes reduced by several orders of magnitude), the absence of significant release forces (such as high pressures and temperatures) and the constantly changing structure of the facility during dismantling.

For projects subject to an EIA, the environmental impact assessment includes the determination, description and evaluation of the main effects upon the objects of legal protection mentioned in § 1a, para. 2 of the AtVfV (people, animals and plants, soil, water, air, climate and landscape, cultural

property and other material goods, including the respective interactions) which are significant for checking the pre-conditions for approval.

In accordance with §§ 4 to 6 of the AtVfV, the licensing authority has to announce projects according to § 7 of the Atomic Energy Act to the public and has to disclose the documents for public inspection. As defined in § 4, para. 4 of the AtVfV, the licensing authority may waive announcement and public disclosure in the process of issuing licenses under §7, para. 3 of the Atomic Energy Act (decommissioning, dismantling, safe enclosure), if, according to § 4, para. 2 of the AtVfV, no additional or other aspects would have to be described in the safety analysis report which gives rise to concern that there may be adverse effects on third parties.

According to § 4, para. 4 of the AtVfV, a waiver of the announcement and disclosure for public inspection shall not be permissible if it is mandatory to prepare an EIA according to the Act on the Environmental Impact Assessment (UVPG).

If announcement and disclosure for public inspection is required, the possibilities to make objections and the hearing are restricted to the project which has been applied for (§ 4, para. 4 sentence 3 in conjunction with para. 2 sentence 4 AtVfV).

According to § 8, para. 1 of the AtVfV, all objections submitted in time shall be discussed by the licensing authority with the applicant and the persons by whom the objections are raised (hearing). If an involvement of third parties would not be required according to § 4, para. 4 of the AtVfV– since no additional or other aspects would have to be described which give rise to concern that there may be adverse effects on third parties – the licensing authority may waive the discussion of objections as defined in § 19b, para. 2 of the AtVfV (cf. also § 7, para. 4 of the Atomic Energy Act).

According to § 2a of the Atomic Energy Act, the EIA is an integral part of the nuclear licensing procedure that is regulated by the provisions of the AtVfV. § 7, para. 4 of the Atomic Energy Act stipulates that, as a rule, all federal, *Länder*, local and other regional authorities whose jurisdiction is involved shall take part in the licensing procedure.

## **5. Supervision**

§ 19, para. 1 of the Atomic Energy Act stipulates, among other things, that the handling of radioactive substances and the possession of facilities of the type referred to in § 7 of the Atomic Energy Act shall be subject to state supervision. Thus, the decommissioning of nuclear facilities and all other measures associated with safe enclosure or dismantling are subject to supervision under nuclear legislation, as was the operation of the facility before its decommissioning.

Within the framework of supervision (accompanying control), the nuclear licensing authority must ensure that, in particular, the provisions of the license pursuant to § 7, para. 3 of the Atomic Energy Act are considered. According to § 20 of the Atomic Energy Act, the nuclear supervisory authority may consult authorised experts for this. This requires clear formulation of the subject of the license. Accordingly, it has to be checked already before granting of the license whether the planned methods and sequences are appropriate and clearly enough defined for decommissioning and whether they ensure the necessary precautions against damage according to the state of the art in science and technology during execution of the planned decommissioning measures. In this respect, it is also to be defined in the license whether and to what extent decisions, e.g. on methods and sequences to be applied during the individual work steps, may remain reserved for the permit procedure within the framework of supervision.

### **5.1 Permit of decommissioning work**

For the practical work during decommissioning of nuclear facilities, adequate permit procedures are required that can be applied for planning and performance of specific dismantling measures. A permit procedure for the decommissioning procedure can be stipulated in the license for decommissioning. During the course of decommissioning, such organisational instrument is of particular importance in guaranteeing radiation protection and occupational safety. All relevant activities in the facility which are to be decommissioned should therefore be subjected to such a procedure in order to take account of the requirements of radiation protection (e.g. IWRS guideline Part II /13/), protection at work and fire protection, physical protection and all other protection objectives related to safety.

For planning, control and monitoring of the work associated with the dismantling, several permit procedures work well in practice. Thus, it is possible, e.g., to manage the specific work steps and auxiliary equipment, the planned separation and cutting methods, devices which are to be used, the

decontamination techniques, the disposal objective, the fire protection measures, the transport measures and the radiation protection measures (housing, extraction, respiratory protection, etc.) for a defined dismantling work by means of a step-by-step dismantling procedure. In this respect, the relevant radiological boundary conditions are to be considered. The step-by-step dismantling procedure enables supervision of, e.g., dose-relevant work at defined work on predefined work items by the authority or authorised experts and subsequent documentation of work performance.

Procedurally, a permit may be granted for an individual dismantling measure which can be structured as follows:

- compilation of the results of simulations with inactive mock-ups for performance of the measures,
- associated work order lists with data on working times, personnel, dose rate, radiological planning, decontamination methods, dismantling schedule, disposal, involvement of authorised experts,
- information on planned further treatment of the radioactive substances, such as subsequent decontamination measures, planned clearance path or conditioning of the parts that cannot be cleared for disposal in a repository or a storage facility as waste packages,
- specification of the applicable radiation protection instructions,
- explanatory documents in form of text and drawings for detailed description of the planned measure.

The documents and auxiliary means used in the permit procedure can be used to document decommissioning procedures, experience during decommissioning and the individual and collective dose of staff for the individual work sequences.

It may be appropriate to continue the work permit procedures already implemented for power operation of the facility according to the regulations of the operating manual (maintenance regulations) and according to IWRS guideline Part II /13/ and to also apply them to dismantling measures.

## 5.2 Documentation

The measures carried out during decommissioning are documented in accordance with the terms of the decommissioning license. This documentation must ensure that the current status of the facility in respect of

- the radioactive inventory and its distribution, and
- the conditions of the buildings, residual operating systems and components still present

is clear and is accessible for official inspection. In addition to this, data concerning radiation protection of the staff and the transfer of radioactive and non-radioactive substances must be documented. The basic requirements for documentation are essentially laid down in the BMI guidelines “Principles for the Applicant's / Licensee's Documentation of Technical Documents Pertaining to the Construction, Operation, and Decommissioning of Nuclear Power Plants“ /11/, “Requirements for the Documentation at Nuclear Power Plants“ /12/ and KTA Safety Standard 1404 “Documentation during the Construction and Operation of Nuclear Power Plants” (see Annex 3). It is only necessary to keep a second set of documentation until the nuclear fuel is removed.

In view of § 1 no. 2 of the Atomic Energy Act, the documentation obligation in terms of the decommissioning license may also comprise safety-relevant findings during dismantling of the facility. Accordingly, it shall e.g. be documented and immediately communicated to the supervisory authority as safety-relevant operating experience if during dismantling of the facility new indications and findings on components that may belong to safety-relevant systems and equipment of nuclear facilities in operation and it is still known to the licensee due to his technical knowledge from own former operation.

For safe enclosure, documentation is to be compiled in such a way that all necessary safety-relevant information is available even in the event of a possible change in licensee and continuation of the decommissioning measures (dismantling of the facility).

This does not affect the radiological protection documentation required by the Radiation Protection Ordinance.

For the purpose of release of the facility including the site from nuclear supervision (completion of dismantling of the facility in the scope described in the license), the competent authority must be provided with a set of documentation under the terms of the license. This documentation must give:

- a description of the status of the site on completion of decommissioning measures,
- the criteria used for clearance and removal, measurement methods and results for all of the structures remaining on the site and for the area of the site itself.

This documentation shall be kept for 30 years from the date of release of the facility from nuclear supervision, analogous to § 70 of the Radiation Protection.

After completion of all decommissioning work, the operator should prepare a final decommissioning report and keep it together with the documentation /17/.

The final decommissioning report summarises the decommissioning, the dismantling of the facility and the final status of the site at the time of release from nuclear supervision or – if the site is converted to another use under nuclear or radiation protection legislation – the status of the facility site at the time of conversion to other use.

## **6. Handling of radioactive and non-radioactive materials from decommissioning**

During decommissioning of nuclear facilities, radioactive residues and radioactive components which have been disassembled or dismantled arise that, according to § 9a of the Atomic Energy Act are either to be utilised without detrimental effects (e.g. by clearance or reuse in another facility licensed under nuclear or radiation protection legislation) or to be properly disposed of as radioactive waste. Regulations relating to the area of waste treatment and clearance of radioactive substances in the decommissioning procedure are contained in the overall complex of related provisions of nuclear legislation (in particular § 2, para. 2 and § 9a of the Atomic Energy Act, §§ 29, 70, 72 to 79 of the Radiation Protection Ordinance, guideline on the control of radioactive waste /10/).

Clearance is an administrative act which effects the exemption of radioactive substances and any movable goods, of buildings, soil areas, facilities or parts of facilities which are activated or contaminated by radioactive substances and which originate from practices pursuant to § 2, para. 1 subpara. 1 (a), (c) or (d) of the Radiation Protection Ordinance governed by the scope of application

a) of the Atomic Energy Act and

b) ordinances based on it and decisions of administrative authorities

for the use, utilisation, disposal, possession or their transfer to third parties as non-radioactive substances, in short, release from nuclear supervision (see Section 6.1). The preconditions for clearance are regulated in § 29 of the Radiation Protection Ordinance (see Section 6.3).

Because during decommissioning also considerable amounts of substances arise which are indeed subject to nuclear supervision but are not contaminated or activated, these substances can be released from nuclear supervision by removal (see Section 6.4).

## **6.1 Release from nuclear supervision**

The release of a facility as defined in § 7, para. 1 of the Atomic Energy Act or of parts thereof from the scope of application of the Atomic Energy Act takes place under the terms of the license according to § 7, para. 3 of the Atomic Energy Act. In the case of activated or contaminated substances, release takes place by clearance according to § 29 of the Radiation Protection Ordinance in a separate administrative act.

Substances and movable goods, buildings, facilities or parts of facilities which are covered by a license under § 7, para. 1 of the Atomic Energy Act but not by § 29 of the Radiation Protection Ordinance may be removed if they do not derive from the controlled area and are not contaminated or activated. A soil area may also be released (removed) from nuclear supervision without clearance according to § 29 of the Radiation Protection Ordinance if its contamination is excluded. The general proceeding for this kind of release (removal) is to be described in a licensing document. This does not affect § 44, para. 3 of the Radiation Protection Ordinance.

In addition to this, the facility including the site with the remaining structures (buildings, systems) can be converted into another facility which is licensed under nuclear or radiation protection legislation (as a new facility or by joining it onto an existing neighbouring facility) without clearance according to § 29 of the Radiation Protection Ordinance. In this case, the procedure defined under nuclear legislation is changed into another procedure under nuclear or radiation protection legislation and thus nuclear supervision is continued.

## **6.2 Measurement methods and sampling**

An essential prerequisite for the clearance of radioactive substances according § 29 of the Radiation Protection Ordinance is the performance of clearance measurements to demonstrate compliance with the clearance criteria according to § 29 of the Radiation Protection Ordinance.

In case a nuclide vector is determined, the sampling strategy plays an important role. It comprises the determination of representative sampling sites at procedural accumulation points as well as the choice of appropriate sampling methods. These sampling methods must consider the chemical properties of the base material and of the contamination and show reproducible removal factors.

The following methods are currently available, among others, for clearance measurement of beta/gamma-contaminated material:

- beta-surface measurement,
- gamma spectrometry,
- total gamma measurement.

These methods shall be applied following the applicable technical standards /21/.

There are also proven methods available for the clearance measurement of alpha-contaminated material. These are alpha spectrometry and total gamma measurement as well as total alpha activity measurement. The methods of measurement for materials from nuclear fuel cycle facilities must be established on a case-by-case basis.

The above-mentioned measurement methods can also be applied for preservation of evidence measurement prior to removal of non-contaminated and non-activated substances.

The prerequisites for the use of a certain measurement technique must first of all be clarified in a preliminary study. In this study, as a rule, representative material samples are to be used to determine the radionuclide mix, the relative proportions of the individual radionuclides (nuclide vector) by means of spectrometric measurement methods and, where required, radionuclide analyses, or balancing measurement methods in the individual case. Further, the spatial activity distribution is to be determined by means of random material samples or for surfaces by means of surface measurements. The “key nuclides” (well measurable radionuclides) are to be defined from the determined radionuclide mix, these “key nuclides” together with the nuclide vector can be used in the clearance measurement to derive the total activity and the activity of the individual nuclides.

The clearance measurement is performed according to the specifications of the administrative clearance act. For the clearance of materials, the most homogenous material batches possible are to be composed with regard to the spatial activity distribution and the radionuclide vector in order to obtain representative measurement results. The clearance measurement is to be performed in the way that the specific activity or contamination of the material is not underestimated (conservatism of the measurement).

### 6.3 Clearance

According to § 29 of the Radiation Protection Ordinance, radioactive substances may be used, utilised, disposed of, possessed or transferred to a third party as radioactive substances and movable goods, buildings, soil areas, facilities or parts of facilities which are activated or contaminated and which originate from practices pursuant to § 2, para. 1 subpara. 1 (a), (c) or (d) of the Radiation Protection Ordinance if the competent authority has issued a clearance decision upon application and compliance with the requirements specified in the clearance notice has been confirmed (e.g. by measurement). Clearance is an administrative act effecting the release from nuclear supervision. The effective dose occurring for members of the public from the cleared substances may only be in the order of 10 microsievert per calendar year (10 microsievert concept).

Clearance is applied for by the licensee, as regulated in § 29, para. 1 sentence 1 of the Radiation Protection Ordinance, and is issued an administrative clearance act. This also applies if for the purpose of clearance of the radioactive substances the licensee makes use of a service provider for the performance of individual processing steps (e.g. decontamination or measurement).

Record keeping and notification to the competent authority on the cleared substances is regulated in § 70 of the Radiation Protection Ordinance. A clearance does not replace a license according to § 7, para. 3 of the Atomic Energy Act.

The clearance regulations provided in § 29 of the Radiation Protection Ordinance are to be applied to those areas in which contamination or activation originating from practices pursuant to § 2, para. 1 (a), (c) or (d) of the Radiation Protection Ordinance cannot be excluded. For materials in controlled areas in which unsealed radioactive substances were handled, contamination cannot be excluded (e.g. controlled area of a nuclear power plant).

The 10 microsievert concept may be considered to be met if the clearance values specified for different clearance options in Appendix III Table 1 of the Radiation Protection Ordinance are complied with and the boundary conditions specified in Appendix IV of the Radiation Protection Ordinance are considered. Appendix IV part A no. 2 of the Radiation Protection Ordinance stipulates that in the individual case proof can be furnished for deviations from the values of Appendix III of the Radiation Protection Ordinance or the boundary conditions specified in Appendix IV of the Radiation Protection

Ordinance – e.g. by submission of expert opinions – that for a specified exposure path only a small dose in the range of only 10 microsievert per calendar year can occur for individual members of the general public. According to § 29, para. 2 sentence 4 of the Radiation Protection Ordinance, the requirements for clearance may not be brought about, caused or facilitated in a targeted manner by mixing or diluting (see also /20/).

Appendix III Table 1 of the Radiation Protection Ordinance includes a list of the following clearance options:

1. an unrestricted clearance of
  - a) solid substances, liquids,
  - b) demolition waste, excavated soil,
  - c) soil areas,
  - d) buildings for reuse and further use;
  
2. clearance of
  - a) solid substances, liquids for removal,
  - b) buildings for demolition,
  - c) metal debris for recycling.

After clearance according to nuclear legislation, solid or liquid substances cleared to be disposed of on a landfill or to be removed in an incinerator facility (2a) as well as metal debris to be recycled (2c) are subject to the provisions of the Closed Substance Cycle and Waste Management Act (Kreislaufwirtschafts- und Abfallgesetz - KrW-/AbfG). Another use or utilisation must be excluded. In this connection, the regulations of § 29, para. 5 of the Radiation Protection Ordinance are to be observed. In the case specified under (2a), the competent authority must have no reason to suspect that the effective dose occurring for members of the public in the order of 10 microsievert per calendar year at the waste-management plant site will be exceeded.

For the clearance of soil areas (1c), only contamination is to be taken into account that has been caused through facilities on the premises. Pre-existing contamination from natural radionuclides and from radioactive fallout resulting from nuclear weapons tests and the Chernobyl accident may not have to be taken into account for clearance, e.g. on the basis of measurements on comparable areas in the environment of a facility.

For clearance of buildings for reuse and further use (1d), the clearance values according to § 29, para. 2 sentence 2 no. 1 (e) and the specifications in Appendix IV part A no. 1 and part D of the Radiation Protection Ordinance are to be complied with.

For clearance of buildings for demolition (2b), the building is subjected to clearance measurements in accordance with the provision of the clearance notice under consideration of the clearance values according to § 29, para. 2 sentence 2 no. 2 (c) of the Radiation Protection Ordinance and then conventionally demolished. According to Appendix IV Part D of the Radiation Protection Ordinance, the clearance measurement of a building shall principally take place at the standing structure. In this case, the waste resulting from the demolition shall not require separate clearance.

The clearance measurement of a building shall principally take place at the standing structure. Only in justified cases, a building can be subjected to clearance measurements after demolition. In this case, measurements have to be performed after demolition in order to prove compliance with the clearance values according to § 29, para. 2 sentence 2 no. 1 (a) (unrestricted clearance of up to 1,000 t/a), no. 1 (c) (unrestricted clearance of more than 1,000 t/a) and no. 2 (a) (clearance for disposal up to 1,000 t/a) of the Radiation Protection Ordinance for the demolition waste (1a, 1b and 2a).

For decommissioning, the competent authority may determine the procedure to meet the clearance requirements pursuant to § 29, para. 2 of the Radiation Protection Ordinance in a license according to § 7, para. 3 of the Atomic Energy Act or in a separate notice (§ 29, para. 4 of the Radiation Protection Ordinance). Within the framework of examination of the clearance measurement procedure of the operator, the authority may request further expert opinions and verify the suitability of certain clearance measurement procedures.

As a rule, the clearance procedure comprises

- the application of the licensee pursuant to § 29, para. 1 sentence 1 of the Radiation Protection Ordinance for clearance to the competent authority. This application includes, e.g., the corresponding work instructions and clearance schedules according to which the clearance procedure is performed.
- the granting of clearance in writing by a notice of the competent authority to the licensee according to § 29, para. 2 sentence 1 of the Radiation Protection Ordinance if only an effective dose in the order of 10 microsievert may occur for members of the public. This notice also specifies, i.e., the requirements (e.g. the measurement procedure) according to which the clearance measurements are to be performed.

- the determination of the radiation protection supervisor or radiation protection commissioner of the facility pursuant to § 29, para. 3 of the Radiation Protection Ordinance whether the results of the clearance measurements comply with the requirements specified in the notice. The clearance measurements and their results are to be documented (§ 70 of the Radiation Protection Ordinance).
- the regulatory control, e.g. through further inspection steps based on random samples, where appropriate, involving an authorised expert within the framework of supervision,
- the further use, utilisation, disposal, possession or their transfer to third parties as non-radioactive substance.

Within the framework of supervision, the competent authority has to control the compliance of the clearance criteria specified in the clearance notice, the sampling and measurement methods and the conditions of the license related to clearance.

In this respect, it is examined on the basis of random samples, where appropriate with the involvement of an authorised expert, whether the determination of the radiation protection supervisor or radiation protection commissioner as defined in the § 29, para. 3 of the Radiation Protection Ordinance has been made that the respective batch released by measurements actually complies with the requirements of the clearance notice.

The control by the authority may comprise:

- checking of documentation,
- checking suitability of the measurement techniques, measuring devices, the use of the measuring devices and specialist qualification of personnel,
- control of compliance with the licensed procedure, and,
- where appropriate, own or by a consulted expert performed random sample measurements.

## **6.4 Removal**

In this guide, removal refers to a proceeding for the release of non-contaminated and non-activated substances as well as movable goods, buildings, facilities or part of facilities (in this section shortly referred to as “substances”) from nuclear supervision, unless the substances stem from the controlled

area. Removal can be applied for substances in areas for which contamination or activation can be excluded due to the operating history and use. Accordingly, a soil area may also be released (removed) from nuclear supervision without clearance according to § 29 of the Radiation Protection Ordinance. The general proceeding for removal is to be described in a licensing document. The absence of contamination and activation for removal of non-contaminated and non-activated substance of soil areas is to be confirmed by appropriate measurements under consideration of the operating history. Type and scope can be specified within the nuclear supervisory procedure on a case-by-case basis. After performance of the specified procedure for release, nuclear supervision terminates without requiring a clearance notice according to § 29 of the Radiation Protection Ordinance.

This does not affect § 44, para. 3 of the Radiation Protection Ordinance., i.e. a distinction is to be made between removal and the case of bringing outside. The latter is the case regulated in § 44, para. 3 of the Radiation Protection Ordinance where movable objects are to be brought outside the controlled area (or upon decision of the authority the supervised area according to § 44, para. 3 sentence 3 of the Radiation Protection Ordinance) with the objective of reuse or repair and it shall be checked whether these potentially contaminated objects fulfil the prerequisites specified in § 44, para. 3 of the Radiation Protection Ordinance. In contrast to this, the removal concerns substances which are not subject to limiting objectives with regard to their use and for which it can be confirmed that they are not contaminated or activated by preservation of evidence measurements.

## **6.5 Treatment and storage of radioactive substances**

The methods for treatment of radioactive substances and wastes arising from the decommissioning of nuclear facilities are essentially comparable with the methods for treating radioactive substances and wastes from the operation of nuclear facilities.

Unlike nuclear power plants or research reactors, nuclear fuel cycle facilities usually only contain contaminated but no activated materials. Both in the case of nuclear reactors and of nuclear fuel cycle facilities, the majority of the substances which arise in the course of total demolition are neither activated nor contaminated.

The same boundary conditions apply for the collection, sorting, conditioning and documentation of radioactive wastes as for operational wastes (cf. Radiation Protection Ordinance, guideline on the

control of radioactive waste /10/, KTA 3604). In order to reduce the volume of waste, the residues should be separated into utilisable substances and radioactive wastes already when they arise.

A reduction in the volume of the radioactive waste may be reached or unnecessary radiation exposure avoided by decay storage of radioactive unsegmented large components. The long-term storage of large components is, as far as the licensing preconditions of § 6 of the Atomic Energy Act or § 7 of the Radiation Protection Ordinance are given, legally admissible. In these cases the further treatment of the large components can take place within the framework of the handling license.

However, as long as the owner of the facility has not yet decided on a type of handling of the components and there are objectively possibilities of utilisation, these substances are not to be considered as radioactive wastes (subjective waste term of § 9a, para. 1 of the Atomic Energy Act). With regard to the clearance objective, thus they can be stored temporarily as radioactive residues.

In order to avoid unnecessary radiation exposure of the personnel, the treatment of radioactive residues only has to take place to a degree that a longer-term storage is possible and the radioactive wastes can later be conditioned without considerable efforts to a form then required for disposal in a repository. If, in particular, contaminated and activated metal parts, for which the nuclide vector indicates a decay of the activity within a foreseeable period of time so that the material can be cleared by measurements or reused in nuclear technology, later utilisation is given preferential consideration instead of disposal.

With regard to later segmentation of large components after storage for an appropriate period, it is to be ensured that radioactive wastes that may arise from utilisation can be brought into the repository. This is objectively no longer possible if the repository has been sealed.

As regards licenses for safe enclosure or dismantling of reactor facilities with the waste management strategy of long-term storage for decay of their radioactivity, the license should be linked to a condition for the protection of life, health and property (§ 1, no. 2 of the Atomic Energy Act) and in view of keeping open of a repository. With this condition it is to be ensured that the party obliged according to § 9a, para. 1 of the Atomic Energy Act exercises its principally unlimited right to choose (utilisation or disposal) in due time. This is to be ensured by a corresponding formulation of the condition. When taking the Konrad repository into operation, but at the latest in due time before the expected end of emplacement, the party obliged should declare bindingly whether it intends to utilise the temporarily stored components in a non-detrimental manner or to properly dispose them of as radioactive wastes.

In the case of non-detrimental utilisation, it has to demonstrate that after termination of emplacement into the Konrad repository no more radioactive wastes will arise from utilisation that require disposal.

The storage of unconditioned wastes (untreated wastes) in the facility must be described and, where necessary, regulated in the licensing notice, as must the preparation for transport or storage of conditioned waste packages on the site of the facility. For the storage of radioactive wastes from operation and decommissioning and radioactive residues for decay storage, construction and operation of an on-site storage facility can be applied for which can be integrated into residual operation during decommissioning and dismantling but after dismantling of the facility it has to be further operated autarkic. According to § 78 of the Radiation Protection Ordinance, the radioactive wastes from previous operation and decommissioning of the facility are to be kept at a storage facility until they can be delivered to a repository and will be called off by the operator of the repository. For optimisation of the decommissioning process, it is also possible to create places for large components in the storage facility under the prerequisites described on it above.

As the legal basis for the licensing of the on-site storage facility § 7, para. 1 of the Radiation Protection Ordinance comes into consideration. However, the on-site storage facility is covered by the decommissioning license pursuant to § 7, para. 3 of the Atomic Energy Act, which may be possible according to § 7, para. 2 of the Radiation Protection Ordinance, it has to be considered that § 7, para. 3 of the Atomic Energy Act in conjunction with § 7, paras. 1, 2 of the Radiation Protection Ordinance can only be referred to as legal basis until completion of the decommissioning of the facility. Storage requires separate licensing beyond this point in time.

Irrespective of guideline on the control of radioactive waste /10/, it may also be specified in the licensing notice under which preconditions external conditioning facilities can be made use of. For external transports that might be necessary in this connection and might require a separate license, the regulations of §§ 16 to 18 of the Radiation Protection Ordinance are relevant.

If third parties are also to be involved in the treatment of decommissioning wastes, a separate license is required for it according to § 7, para. 1 of the Radiation Protection Ordinance. The coverage of the license granted according to § 7, para. 3 of the Atomic Energy Act for the treatment of the radioactive wastes of third parties also treated within the framework of decommissioning is not sufficient since the consent purpose of the respective decommissioning license according to § 7, para. 3 of the Atomic Energy Act is directed to the decommissioning of the actual facility. To what extent the existing

decommissioning license for the facility has to be modified, is to be determined and, where required, a modification license is to be granted pursuant to § 7, para. 3 of the Atomic Energy Act.

## 7. Literature

- /1/ IAEA: Safety Guide on Decommissioning of Nuclear Fuel Cycle Facilities, Safety Standards Series No. WS-G-2.4, Vienna, 2001
- /2/ IAEA: Safety Guide on Decommissioning of Nuclear Power and Research Reactors, Safety Standards Series No. WS-G-2.1, Vienna, 1999
- /3/ IAEA: Safety Guide on Decommissioning of Medical, Industrial and Research Facilities, Safety Standards Series No. WS-G-2.2, Vienna, 1999
- /4/ IAEA: Safety Fundamentals on the Principles of Radioactive Waste Management, Safety Series No. 111-F, Vienna, 1995
- /5/ IAEA: Safety Requirements on Predisposal Management of Radioactive Waste Including Decommissioning, Safety Standards Series No. WS-R-2, Vienna, 1999
- /6/ Handbook on Nuclear Safety and Radiation Protection, issued by the Federal Ministry for the Environment, Nature Conservation and Reactor Safety, distributed by the Federal Office for Radiation Protection, Salzgitter, as of 07/09, <http://www.bfs.de/bfs/recht/rsh>
- /7/ Clearance of materials, buildings and sites with negligible radioactivity from practices subject to reporting and licensing, recommendations of the Commission on Radiological Protection, adopted at the 151<sup>st</sup> meeting on 12 February 1998, published in: Reports of the Commission on Radiological Protection, Vol. 11
- /8/ Safety criteria for nuclear power plants, announcement of the Federal Minister of the Interior of 21 October 1977 (Federal Gazette 1977, No. 206)
- /9/ IAEA: Principles for the Exemption of Radiation Sources and Practices from Regulatory Control, Safety Series No. 89, Vienna, 1988; ISBN 92-0-123888-6, (jointly sponsored by IAEA and OECD/NEA)

- /10/ Guideline on the control of radioactive waste with negligible heat generation that is not handed over to a *Land* collecting facility, of 16 January 1989 (Federal Gazette 1989, No. 63a), last amendment of 14 January 1994 (Federal Gazette, No. 19)
- /11/ Principles for the Applicant's / Licensee's Documentation of Technical Documents Pertaining to the Construction, Operation, and Decommissioning of Nuclear Power Plants, announcement of the Federal Minister for the Environment, Nature Conservation and Nuclear Safety of 19 February 1988 (Federal Gazette 1988, No. 56)
- /12/ Requirements for the Documentation at Nuclear Power Plants, circular of the Federal Minister of the Interior of 5 August 1982 (Joint Ministerial Gazette (GMBL.) 1982, page 546)
- /13/ Guideline for the Protection against Radiation of Personnel during the Execution of Maintenance Work, Modification, Disposal and the Dismantling in Nuclear Installations and Facilities Part II: The Radiation Protection Measures to be taken during the Operation or Decommissioning of an Installation or Facility (IWRS II) of 17 January 2005 (Joint Ministerial Gazette (GMBL.) 2005, No. 13)
- /14/ Safety requirements on the storage of low and intermediate level waste in the longer term, RSK recommendation, annex to the minutes of the 357<sup>th</sup> RSK meeting on 5 December 2002
- /15/ Safe Decommissioning for Nuclear Activities; Proceedings of an International Conference on Safe Decommissioning for Nuclear Activities organised by the International Atomic Energy Agency and hosted by the Government of Germany through the Federal Office for Radiation Protection and held in Berlin, 14 – 18 October 2002; printed by the IAEA in Austria, August 2003
- /16/ Act on the Joint Convention of 5 September 1997 on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management of 13 August 1998, (Federal Law Gazette (BGBl.) 1998, Part II, No. 31)
- /17/ IAEA: Safety Requirements on Decommissioning of Facilities Using Radioactive Material, Safety Standards Series No. WS-R-5, Vienna, 2006

- /18/ IAEA: Safety Guide on Release of Sites from Regulatory Control on Termination of Practices, Safety Standards Series No. WS-G-5.1, Vienna, 2006
- /19/ IAEA: Safety Guide on Storage of Radioactive Waste, Safety Standards Series No. WS-G-6.1, Vienna, 2006
- /20/ Final report on research project StSch 4378, general guideline for clearance of radioactive substance according to § 29 of the Radiation Protection Ordinance, January 2004
- /21/ DIN 25457, Parts 1-2 and 4-7, Activity measurement methods for the release of radioactive waste materials and nuclear facility components, German industrial norm, Part 1 of 1993, Part 2 of 1995, Part 4 of 1993, Part 5 of 1996, Part 6 of 2000, Part 7 of 2006

## **8. Annex 1: Definition of terms**

Below is an explanation of the terms which are used in this document in connection with the decommissioning and safe enclosure or dismantling of nuclear facilities:

### **“Clearance”**

“Clearance is an administrative act which effects the release of radioactive substances and any movable goods, buildings, soil areas, facilities or parts of facilities which are activated or contaminated by radioactive substances and which originate from practices pursuant to § 2, para. 1 (a), (c) or (d), governed by the scope of application

a) of the Atomic Energy Act and

b) ordinances based on it and decisions of administrative authorities

for the use, utilisation, disposal, possession or their transfer to a third party as non-radioactive substances.“

A distinction shall be made between unrestricted clearance (cf. Radiation Protection Ordinance § 29, para. 2 sentence 2 no. 1 and Radiation Protection Ordinance Appendix III, Table 1) without specific type of utilisation or use and the clearance of solid substances and liquids to be disposed of, of buildings for demolition or of metal debris to be recycled (cf. Radiation Protection Ordinance § 29, para. 2 sentence 2 no. 2 and Radiation Protection Ordinance Appendix III, Table 1) aimed at a specific type of utilisation or use.

### **“Decommissioning”**

“The word “decommissioning” is used both as single word and as compound term (e.g. decommissioning procedure) in this guide generally in the wider sense as generic term for all activities aimed at decommissioning (including safe enclosure and dismantling). This is in accordance with the technical and international parlance. In contrast, the term “decommissioning” in the Atomic Energy Act (decommissioning, safe enclosure, dismantling) is limited to the measures in the phase between final cessation of operation on the one hand, and the beginning of safe enclosure or

dismantling of the facility or parts thereof on the other hand. This definition – as “decommissioning in the narrower sense” – is only used in this guide if a link is established to the legal framework, in particular the Atomic Energy Act or if decommissioning, safe enclosure and dismantling are listed.“

#### **“Decommissioning concept”**

“It must be demonstrated in a concept already within the framework of the licensing procedure for construction and operation of a facility, i.e. well in advance of decommissioning, that the facility can be decommissioned in compliance with the radiation protection regulations.“

#### **“Decommissioning plan”**

“The decommissioning plan contains specifications on all measures planned on decommissioning, safe enclosure or the dismantling of the facility or parts thereof which, in particular, should make it possible to assess whether the measures applied for do not impair or prevent further measures, and whether an appropriate order of the dismantling measures is provided. The documents shall describe by which procedures the planned measures are to be implemented and which possible effects the measures, according to the respective stage of planning, may have on objects of legal protection pursuant to § 1 a of the AtVfV.“

#### **“Deconstruction”**

“The synonymous term deconstruction is also used for dismantling.“

#### **“Dismantling of the facility”**

“The dismantling of a nuclear facility includes removal of structures (buildings, systems, components), which were the subject of the license for construction and operation of the facility in accordance with § 7, para. 1 of the Atomic Energy Act or are to be evaluated as such.”

### **“Dismantling of parts of the facility”**

“The dismantling of parts of a nuclear facility means the disassembly of certain structures.”

Thereby, the dismantling of parts of the facility may include individual components, systems or even whole buildings.

As a rule, the dismantling of parts of a facility is a possibility if these neither come into consideration for safe enclosure nor will be required for the future use of the remaining facility.

### **“Facility”**

“The facility includes all parts which are covered in a licensing procedure as defined in § 7 of the Atomic Energy Act.“

Since (with the exception of safe enclosure) the facility is in a state of constant physical change during the decommissioning procedure, type and extent of the facility can alter as decommissioning work progresses, e.g. by releases from supervision.

### **“Operation”**

“Operation covers all conditions and procedures in the facility between implementation of the first partial operating license and final cessation of this operation.“

If the operator has finally stopped power operation or production in the facility then, the so-called post-operational phase begins if the operating license continues to be valid.

### **“Post-operational phase“**

“The post-operational phase of a nuclear facility covers the period between final cessation of power operation or production in the facility and the issue of an enforceable license for decommissioning, for

safe enclosure or for dismantling as defined in § 7, para. 3 of the Atomic Energy Act to the owner of the nuclear facility.“

The synonymous term "operation during outage" is also used here for the post-operational phase.

### **“Power Operation”**

“The operating phase of a nuclear power plant in which nuclear heat is produced in a targeted manner.“

For research reactors, the term power operation it is used correspondingly. The term production operation is usually used for nuclear fuel cycle facilities and is equivalent to power operation.

### **“Preliminary study”**

“The preliminary study is an analysis to determine the radionuclide mix, the relative proportions of the radionuclides and their geometric distribution in a material batch.“

### **“Release”**

“The release of a facility as defined in § 7, para. 1 of the Atomic Energy Act or of parts thereof from the scope of application of the Atomic Energy Act (also: release from nuclear supervision) takes place under the terms of § 7, para. 3 of the Atomic Energy Act. In the case of activated or contaminated substances, release takes place by clearance according to § 29 of the Radiation Protection Ordinance in a separate administrative act.“

### **“Removal”**

“In this guide, removal refers to the release of non-contaminated and non-activated substances as well as movable goods, buildings, facilities or part of facilities without clearance according to § 29 of the Radiation Protection Ordinance from nuclear supervision on the basis of a proceeding described

in the license pursuant to § 7, para. 3 of the Atomic Energy Act. Accordingly, a soil area can also be released (removed) from nuclear supervision if its contamination is excluded.“

#### **“Residual operation”**

“Residual operation is referred to as the operation of all supply, safety and auxiliary systems required for decommissioning and the operation of systems and equipment required for the dismantling of components, systems and buildings after granting of the decommissioning license.“

#### **“Residues, radioactive”**

“Radioactive substances, radioactive components which have been dismantled or removed, building parts (debris from demolition) and removed soil as well as movable goods, being contaminated or activated for which the way of utilisation or disposal has not been decided yet, until decision of the licensee that they are to be classified as radioactive waste. The residual material in this sense can

- be utilised in the own or another facility which may lead to the production of radioactive wastes, or
- immediately or after decay storage be cleared according to § 29 of the Radiation Protection Ordinance.“

#### **“Safe Enclosure”**

“Safe enclosure covers the state and the procedures in a shut down nuclear facility and after removal of the nuclear fuel, whereby the essential components of this facility remain unchanged in their respective state for a protracted period of time and the radioactive inventory remains safely contained.“

Regardless of the fact that the radioactive inventory must always be safely contained, in this case a certain technical condition of the facility is meant, which is also mentioned as an independent type of situation as defined in § 7, para. 3 of the Atomic Energy Act.

### **“Safety management system”**

“A safety management system comprises all definitions, regulations and organisational aids provided within the company to carry out safely all safety-relevant tasks and to check and improve target fulfilment. The safety management system represents a tool with which the company promotes and supports a high level of safety culture.“

### **“Shutdown”**

“A shutdown of a facility is each cessation or interruption of power operation.“

Shutdown as such is covered by the operating license.

### **“Standstill”**

“Standstill is the state of a facility after it has been shut down. Availability of the systems depends upon the regulations for standstill of the facility laid down in the operating manual.“

### **“Substances, radioactive”**

“Radioactive substances in terms of § 2, para. 1 of the Atomic Energy Act shall refer to all substances containing one or more radionuclides and whose activity or specific activity in conjunction with nuclear energy or radiation protection cannot be disregarded under the provisions of this Act or a statutory ordinance promulgated on the basis of this Act.“

The term also covers radioactively contaminated components and building structures.

### **“Wastes, radioactive”**

“According to § 3, para. 2 of the Atomic Energy Act, radioactive wastes are radioactive substances pursuant to § 2, para. 1 of the Atomic Energy Act, which, according to § 9a of the Atomic Energy Act,

are to be disposed of in a regulated manner, except discharges pursuant to § 47 of the Radiation Protection Ordinance.”

## **9. Annex 2: Classification of the BMI/BMU and KTA standards in respect to their applicability to decommissioning**

The announcements issued by the BMI/BMU and the KTA standards were assessed to ascertain their applicability to the decommissioning of nuclear facilities and were divided into the following three categories:

Category 1: The rule is generally applicable and is therefore also to be taken into account for decommissioning procedures.

Category 2: The rule is not relevant to decommissioning procedures. However, in case of construction measures that might be performed within the framework of decommissioning or significant changes of use it can be applied adapted to protection objectives in terms of Category 3.

Category 3: The rule is applicable after adaptation to the protection objectives or is partially applicable to decommissioning procedures, taking account of the changed, in many respects reduced, potential hazard and the modified requirements relative to construction and operation.

The listing given in the Handbook on Nuclear Safety and Radiation Protection /6/ was used.

Comments on the regulations assigned to Category 3, which are applicable after adaptation to the protection objectives or are partially applicable, are given in Annex 3.

RS Handbook	Status 07/09 3. Announcements of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and of the Federal Ministry of the Interior (precursor)	Category
3.1	Nuclear Power Plant Safety Criteria, Promulgation as of October 21, 1977 (Federal Gazette No. 206 of 3 November 1977)	3
3.2	Guideline to the Proof of the Technical Qualification of Nuclear Power Plant Personnel of 14 April 1993 (Joint Ministerial Gazette (GMBI.) 1993, No. 20, page 358)	3
3.3	Guideline Relating to the Proof of the Technical Qualification of Research Reactor Personnel of 16 February 1994 (Joint Ministerial Gazette (GMBI.) 1994, No. 11, page 366)	3
3.4	Guidelines Concerning the Requirements for Safety Specifications for Nuclear Power Plants of 27 April 1976 (Joint Ministerial Gazette (GMBI.) 1976, No. 15, page 199)	3
3.5	Checklist with Layout of a Standard Safety Analysis Report for Nuclear Power Plants with Pressurised Water Reactor or Boiling Water Reactor of 26 July 1976 (Joint Ministerial Gazette (GMBI.) 1976, No. 26, page 418)	3
3.6	Guideline for the Protection of Nuclear Power Plants against Pressure Waves from Chemical Reactions by Means of the Design of Nuclear Power Plants with Regard to Strength and Induced Vibrations and by Means of the Adherence to Safety Distances of 13 September 1976 (Federal Gazette 1976, No. 179)	2
3.7.1	Compilation of Information Required for Review Purposes under Licensing and Supervisory Procedures for Nuclear Power Plants of 20 October 1982 (Federal Gazette 1983, No. 6a)	3
3.7.2	Summary of the Data required for the Building Inspection of Nuclear Facilities of 6 November 1981 (Joint Ministerial Gazette (GMBI.) 1981, No. 33, page 518)	3
3.8	Basic Principles for the Issue of Subcontracts by Specialist Assessors of 29 October 1981 (Joint Ministerial Gazette (GMBI.) 1981, page 517)	1
3.9.1	Principles for the Applicant's/Licensee's Documentation of Technical Documents Pertaining to the Construction, Operation and Decommissioning of Nuclear Power Plants of 19 February 1988 (Federal Gazette 1988, No. 56)	1
3.9.2	Requirements for the Documentation at Nuclear Power Plants of 5 August 1982 (Joint Ministerial Gazette (GMBI.) 1982, page 546)	3
3.10	Implementation of the Radiation Protection Ordinance and the X-ray Ordinance, Reporting of Special Events of 15 July 2002 (Joint Ministerial Gazette (GMBI.) 2002, No. 31, page 637)	2
3.11	Safety Requirements for Nuclear Fuel Supply Facilities; April 1997 and June 2004 BMU RS III 3	3
3.12	Data for the Evaluation of Site Properties for Nuclear Power Plants of 11 June 1975 (Umwelt 1975, No. 43)	2
3.13	Safety Criteria for the Disposal of Radioactive Wastes in a Mine of 20 April 1983 (Joint Ministerial Gazette (GMBI.) 1983, page 220)	2
3.14	Design Guidelines and Reference Data for Iodine Sorption Filters for the Separation of Gaseous Fission Iodine at Nuclear Power Plants of 25 February 1976 (Joint Ministerial Gazette (GMBI.) 1976, page 168)	2
3.18	Licenses under § 3, para. 1 of the Radiation Protection Ordinance or § 6 of the Atomic Energy Act Concerning the Intermediate Storage of Depleted and/or Natural and Enriched Uranium in the Form of Uranium Hexafluoride (UF <sub>6</sub> ) Topic: Licensing Assumptions and Requirements of 15 February 1979 (Joint Ministerial Gazette (GMBI.) 1979, No. 8, page 91)	2

RS Handbook	Status 07/09 3. Announcements of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and of the Federal Ministry of the Interior (precursor)	Category
3.19	Guideline According to the Radiation Protection Ordinance and the X-ray Ordinance on Occupational Medical Care for Occupationally Exposed Persons by Approved Medical Practitioners of 18 December 2003 ((Joint Ministerial Gazette (GMBL.) 2004, No. 19, page 350)	1
3.20	Radiological Protection Control by Biological Indicators: Chromosome Aberration Analysis at the Institute for Radiological Hygiene of the Federal Health Office of 9 March 1983 (Joint Ministerial Gazette (GMBL.) 1983, page 176)	2
3.21	Interpretation of § 4, para. 4 sentence 1 no 2e of the Radiation Protection Ordinance of 20 September 1979 (Joint Ministerial Gazette (GMBL.) 1979, page 631) (May still be relevant for older decommissioning licenses.)	3
3.23	Guideline for the Emission and Immission Monitoring of Nuclear Facilities of 7 December 2005 (Joint Ministerial Gazette (GMBL.) 2006, No. 14 - 17)	1
3.24	Guideline for Inspection Intervals for Leak-tightness Testing on Contained Radioactive Substances of 20 January and 4 February 2004 (Joint Ministerial Gazette (GMBL.) 2004, No. 27, page 530)	1
3.25	Principles Relating to the Provision to be Made for the Handling and Disposal of Spent Fuel of Nuclear Power Plants of 19 March 1980 (Federal Gazette 1980, No. 58)	1
3.27	Guideline Relating to the Assurance of the Necessary Knowledge of the Persons otherwise Engaged in the Operation of Nuclear Power Plants of 30 November 2000 (Joint Ministerial Gazette (GMBL.) 2001, No. 8, page 153)	3
3.28	Criteria for the Preselection of Sites for Fuel Reprocessing Plants of 15 January 1981 (Joint Ministerial Gazette (GMBL.) 1981, No. 5, page 56)	2
3.29	Regulation of legislation competencies for the transport of radioactive substances (Nuclear Fuels and other Radioactive Substances) (BMU RS II 1, as of March 1993)	2
3.31	Recommendations for the Planning of Emergency Control Measures by the Licensees of Nuclear Power Plants of 1977 (Joint Ministerial Gazette (GMBL.) 1977, No. 4, page 48)), amended by Announcement of 18 October 1977 (Joint Ministerial Gazette (GMBL.) 1977, No. 30, page 664) and the Guideline concerning Emission and Immission Monitoring of Nuclear Installations (REI) (Joint Ministerial Gazette (GMBL.) 1993, No. 29, page 502)	3
3.33.1	Guidelines for the Assessment of the Design of PWR Nuclear Power Plants against Incidents pursuant to Sec. 28, para. 3 of the Radiation Protection Ordinance (Incident Guidelines ) of 18 October 1983 (Federal Gazette 1983, No. 245a)	3
3.33.2	Accident Calculation Bases for the Guidelines for Assessing the Design of PWR Power Plants under the terms of § 28, para. 3 of the Radiation Protection Ordinance of 18 October 1983 (Federal Gazette 1983, No. 245a), version of Section 4 "Calculation of Radiological Exposure" of 29 June 1994 (Federal Gazette 1994, No. 222a), Revision of Section 4 "Calculation of Radiological Exposure" according to § 49 of the Radiation Protection Ordinance of 20 July 2001, adopted at 186th meeting of the Commission on Radiological Protection on 11 September 2003, published in Issue 44, 2004 in the Series "Reports of the Commission on Radiological Protection"	1
3.34	Framework guideline on the form of assessment reports in the nuclear administrative procedure of 15 December 1983 (Joint Ministerial Gazette (GMBL.) 1984, No. 2, page 21)	1
3.35	Checklist Items for Application Documents in the Licensing Procedures for Installations for the Generation of Ionising Radiation of 12 November 2003 (Joint Ministerial Gazette (GMBL.) 2004, No. 1, No. 9)	2
3.37	Recommendations Concerning the Regulatory Content of Decisions Relating to the Release of Radioactive Materials from Nuclear Power Plants with Light Water Reactors of 8 August 1984 (Joint	1

RS Handbook	Status 07/09 3. Announcements of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and of the Federal Ministry of the Interior (precursor)	Category
	Ministerial Gazette (GMBL.) 1984, No. 21, page 327)	
3.38	Guideline Relating to Programs for the Preservation of Technical Qualification of Responsible Shift Personal at Nuclear Power Plants of 1 September 1993 (Joint Ministerial Gazette (GMBL.) 1993, No. 36, page 645)	3
3.39	Guideline for the Content of the Examination of Specialist Knowledge of Responsible Shift Personnel in Nuclear Power Plant of 23 April 1996 (Joint Ministerial Gazette (GMBL.) 1996, No. 26, page 555)	3
3.40	Guideline Relating to the Technical Qualification Required in Radiological Protection according to the Radiation Protection Ordinance of 21 June 2004 (Joint Ministerial Gazette (GMBL.) 2004, No. 40/41, S. 799), amendment of 19 April 2006 (Joint Ministerial Gazette (GMBL.) 2006, No. 38)	1
3.41	Guideline Relating to the Procedure for the Preparation and Implementation of Maintenance Work and Modifications at Nuclear Power Plants of 1 June 1978 (Joint Ministerial Gazette (GMBL.) 1978, No. 22, page 342), currently being revised	1
3.42.1	Guideline for Physical Radiological Protection Controls for Determining Body Doses Part 1: Determination of Body Dose due to External Radiation Exposure (§§ 40, 41, 42 of the Radiation Protection Ordinance; § 35 of the X-ray Ordinance) of 8 December 2003 (Joint Ministerial Gazette (GMBL.) 2004, No. 22, page 410)	1
3.42.2	Guideline for Physical Radiological Protection Controls for Determining Body Doses Part 2: Determination of Body Dose due to Internal Radiation Exposure (Incorporation Monitoring) (§§ 40, 41, 42 of the Radiation Protection Ordinance) of 12 January 2007 (Joint Ministerial Gazette (GMBL.) 2007, No. 31/32, page 623), Appendices 1 to 6, Appendix 7.1, Appendix 7.2, Appendix 7.3, Appendix 7.4	1
3.43.1	Guideline for the Protection against Radiation of Personnel during the Execution of Maintenance Work in Nuclear Power plants with Light Water Reactors: Part I: The Precautionary Protective Measures to be taken during the Planning of the Plant – IWRS I of 10 July 1978 (Joint Ministerial Gazette (GMBL.) 1978, No. 28, page 418), currently being revised	3
3.43.2	Guideline for the Protection against Radiation of Personnel during the Execution of Maintenance Work, Modification, Disposal and the Dismantling in Nuclear Installations and Facilities: Part II: The Radiation Protection Measures to be taken during the Operation or Decommissioning of an Installation or Facility – IWRS II of 17 January 2005 (Joint Ministerial Gazette (GMBL.) 2005, No. 13, page 258)	1
3.44	Verification of the License's Monitoring of Radioactive Effluents from Nuclear Power Plants of 5 February 1996 (Joint Ministerial Gazette (GMBL.) 1996, No. 9/10, page 247)	1
3.45	Licenses under the terms of § 3, para. 1 of the Radiation Protection Ordinance for the Mobile Use and Storage of Radioactive Materials in the Context of Non-destructive Material Testing of 14 November 1991 (Joint Ministerial Gazette (GMBL.) 1992, No. 6, page 120)	2
3.46.1	License under the terms of § 8, para. 1 of the Radiation Protection Ordinance on the Transport of Radioactive Materials for Irradiation Tests in the Context of Non-destructive Material Testing of 29 May 1978 (Joint Ministerial Gazette (GMBL.) 1978, No. 21, page 334)	2
3.46.2	Instruction Sheet for the Carriage of Radioactive Materials for Radiographic Examinations within the Frame of the Non-destructive Testing of Materials of 20 November 1981 (Joint Ministerial Gazette (GMBL.) 1982, No. 2, page 22)	2
3.47	Licenses under § 20 of the Radiation Protection Ordinance (Sample License for Activities Subject to Licensing in Foreign Installations or Facilities) of 21 September 1990 and 2 November 1990 (Joint Ministerial Gazette (GMBL.) 1990, No. 33, page 848)	1
3.48	Guideline for the Design Approval of Ionisation Chamber Smoke Detectors of 15 February 1992 (Joint	2

RS Handbook	Status 07/09 3. Announcements of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and of the Federal Ministry of the Interior (precursor)	Category
	Ministerial Gazette (GMBI.) 1992, No. 8, page 150)	
3.49	Interpretations of the Safety Criteria for Nuclear Power Plants Single Failure Concept - Principles for the Application of the Single Failure Criterion of 2 March 1984 (Joint Ministerial Gazette (GMBI.) 1984, No. 13, page 208)	2
3.50	Interpretations of the Safety Criteria for Nuclear Power Plants of 17 May 1979 (Joint Ministerial Gazette (GMBI.) 1979, No. 14, page 161) on Safety Criterion 2.6: Effects from External Events on Safety Criterion 8.5: Heat Removal from the Containment	2
3.51	Interpretations of the Safety Criteria for Nuclear Power Plants of 28 November 1979 (Joint Ministerial Gazette (GMBI.) 1980, No. 5, page 90) on Safety Criterion 2.2: Testability on Safety Criterion 2.3: Radiation Exposure in the Environment on Safety Criterion 2.6: Effects from External Events on Safety Criterion 2.7: Protection against Fire and Explosion on Supplementary Interpretation of Safety Criterion 4.3: Residual-Heat Removal after Loss-of-Coolant	2
3.52.2	Explanations regarding the Reporting Criteria for Notifiable Events in Facilities for the Fissioning of Nuclear Fuels (12/04)  - Compilation of Terms used in the Reporting Criteria (Facilities for the Fissioning of Nuclear Fuels) (05/04)  - Reporting Form (Facilities for the Fissioning of Nuclear Fuels) (04/04)	1
3.52.3	Explanations regarding the Reporting Criteria for Notifiable Events in Facilities not used for Fissioning Nuclear Fuels (status), see also 3.60  - Reporting Form (Facilities not used for Fissioning Nuclear Fuels) (12/92)	1
3.52.4	Reporting of an Indication Regarding Contamination or Dose Rate related to the Transportation of emptied Spent Nuclear Fuel Shipping Casks, Casks with Irradiated Fuel Elements and Casks with Vitrified High-level Fission Products (8/00)  - Reporting Form (Containers) (7/00)	1
3.52.5	Explanations regarding the Reporting Criteria for Notifiable Events in Facilities used for Fissioning Nuclear Fuels – for Application in Research Reactors (11/92)	1
3.53	Guideline for the Content of the Examination of Specialist Knowledge of Responsible Shift Personnel in Research Reactors of 14 November 1997 (Joint Ministerial Gazette (GMBI.) 1997, No. 42, page 794)	3
3.54.1	Recommendation for Remote Monitoring of Nuclear Power Plants of 12 August 2005 (Joint Ministerial Gazette (GMBI.) 2005, No. 51, page 1049)	3
3.54.2	Recommendation for Calculating the Fee as defined in § 5 of the AtKostV for the Remote Monitoring of Nuclear Power Plants of 21 January 1983 (Joint Ministerial Gazette (GMBI.) 1983, No. 8.,page 146)	3
3.55.1	Model Rules for the Use of the Collecting Facilities of the <i>Länder</i> for Radioactive Wastes in the Federal Republic of Germany of 17 March 1981 (Joint Ministerial Gazette (GMBI.) 1981, No. 11, page 163)	2
3.55.2	Basic Concept for the Extension of the Federal Collecting Facility for Radioactive Wastes of 26 October 1981 (Joint Ministerial Gazette (GMBI.) 1981, No. 32, page 511)	2
3.56	International Scale for Significant Events in Nuclear Power Plants (INES), BMU Summary (1993)	1

RS Handbook	Status 07/09 3. Announcements of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and of the Federal Ministry of the Interior (precursor)	Category
3.57.1	Requirements Relating to the Physical Protection Service and Physical Protection Officers in Nuclear Installations and Facilities of 4 July 2008 (Joint Ministerial Gazette (GMBI.) 2008, No. 39, page 810)	3
3.57.3	Guideline for Protecting LWR Nuclear Power Plants against Disruptive Actions or other Interference by third Parties of 6 December 1995 (Joint Ministerial Gazette (GMBI.) 1996, No. 2, page 32) (without text)	3
3.58.1	Guideline for Dealing with Compensation Claims under the Terms of § 38, para 2 of the Atomic Energy Act following the Chernobyl Reactor Accident (Compensation Guidelines) of 21 May 1986 (Federal Gazette 1986, No. 95)	2
3.58.2	Guideline for Compensation According to Equitable Principles due to Losses for Certain Types of Vegetables (Equity Guideline Vegetables) of 2 June 1986 (Federal Gazette 1986, No. 105)	2
3.58.3	Guideline for a General Compensation Ruling in Accordance with Equitable Principles for Losses Resulting from the Chernobyl Reactor Accident (General Equity Guideline) of 24 July 1986 (Federal Gazette 1986, No. 140)	2
3.59	Guideline on the Control of Radioactive Wastes with Negligible Heat Production, which are not Delivered to a Federal Collecting Facility of 16 January 1989 (Federal Gazette No. 63a, 1989), Last Supplement of 14 January 1994 (Federal Gazette 1994, No. 19)	1
3.60	Guideline for the Control of Radioactive Residues and Radioactive Wastes of 19 November 2008 (Federal Gazette 2008, No. 197)	1
3.61	Guideline for the Technical Qualification of Radiation Protection Officers at Nuclear Power Plants and Other Facilities for Fission of Nuclear Fuels of 10 December 1990 (Joint Ministerial Gazette (GMBI.) 1991, No. 4, page 56)	3
3.62	Guideline Relating to Measures for the Protection of Facilities of the Nuclear Fuel Cycle and Other Nuclear Facilities Against Disturbances or Other Interference by Individuals Entitled to Access to the Facility of 28 January 1991 (Joint Ministerial Gazette (GMBI.) 1991, No. 9, page 228)	3
3.63	Guideline for the Protection of Radioactive Substances Against Interference or other Actions by Third Parties During Transportation of 4 December 2003 (Joint Ministerial Gazette (GMBI.) 2004, No. 12, page 238) (without text)	2
3.64	Requirements on Security Personnel during Transportation of Radioactive Materials of 4 June 1996 (Joint Ministerial Gazette (GMBI.) 1996, No. 29, page 621 and No. 33, page 673)	2
3.65	Requirements on Courses for Imparting Basic Nuclear Knowledge for Responsible Shift Personnel in Nuclear Power Plants - Criteria for Recognition – of 10 October 1994	2
3.67	Guideline concerning Requirements for Individual Dose Measuring Facilities in Accordance with the Radiation Protection and X-Ray Ordinance of 10 December 2001 (Joint Ministerial Gazette (GMBI.) 2002, No. 6, page 136)	2
3.68	Security Measures for Protecting Nuclear Facilities with Category III Nuclear Material of 20 April 1993 (Joint Ministerial Gazette (GMBI.) 1993, No. 20, page 365) (without text)	3
3.69.1	Guideline for the Monitoring of Radioactivity in the Environment in Accordance with the Act on Radiological Protection Provisions Part I: Measurement Programme for Normal Operation (Routine Measurement Programme) of 28 July 1994 (Joint Ministerial Gazette (GMBI.) 1994, No. 32, page 930), currently being revised	2
3.69.2	Guideline for the Monitoring of Radioactivity in the Environment in Accordance with the Act on Radiological Protection Provisions Part II: Measurement Programme for Intensive Operation (Intensive Measurement Programme) of 19	2

RS Handbook	Status 07/09 3. Announcements of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and of the Federal Ministry of the Interior (precursor)	Category
	January 1995 (Joint Ministerial Gazette (GMBI.) 1995, No. 14, page 261), currently being revised	
3.71	Guideline relating to the Technical Qualification of Responsible Persons in Facilities for the Production of Fuel Elements for Nuclear Power Plants of 30 November 1995 (Joint Ministerial Gazette (GMBI.) 1996, No. 2, page 29)	3
3.73	Guide to the Decommissioning of Facilities as defined in § 7 of the Atomic Energy Act of 26 June 2009 (Publication is under Preparation)	1
3.74.1	Guidelines for the Performance of Periodic Safety Reviews (PSRs) for Nuclear Power Plants in the Federal Republic of German, currently being revised <ul style="list-style-type: none"> <li data-bbox="368 763 1150 792">- Fundamentals for Periodic Safety Reviews for Nuclear Power Plants</li> <li data-bbox="368 808 767 837">- Guideline Safety Status Analysis</li> <li data-bbox="368 853 831 882">- Guideline Probabilistic Safety Analysis</li> <li data-bbox="368 898 1158 927">- Announcement of 18 August 1997 (Federal Gazette 1997, No. 232 a)</li> </ul>	2
3.74.2	Guideline for the Performance of Periodic Safety Reviews (PSRs) for Nuclear Power Plants in the Federal Republic of German, currently being revised <ul style="list-style-type: none"> <li data-bbox="368 1032 1374 1088">- Guideline Deterministic Security Analysis, Announcement of 25. June 1998 (Federal Gazette 1998, No. 153)</li> </ul>	2
3.74.3	Guideline for the Performance of the Safety Review According to § 19 of the Atomic Energy Act <ul style="list-style-type: none"> <li data-bbox="368 1167 831 1196">- Guideline Probabilistic Safety Analysis</li> </ul> Announcement of 30 August 2005 (Federal Gazette 2005, No. 207)	2
3.75	Checklist for Protecting other Radioactive Material and Small Amounts of Nuclear Fuel Against Diversion from Installations and Facilities of 3 April 2003, BMU circular of 10 July 2003 – RS I 6 13151-6/18	1
3.79	Provisions against Damage Beyond Design-Basis Accidents, BMU circular of 15 July 2003 RS I 3 – 10100/0	3
3.80	Resolution of the <i>Länder</i> Committee for Nuclear Energy (LAA) on Decisions according to the Radiation Protection Ordinance taking Effect beyond the Territory of a Country, BMU Circular of 8 December 2003 RS I 1 – 17031/47	1
3.81	Fundamentals of Safety Management Systems in Nuclear Power Plants, BMU Announcement of 29 June 2004 (Federal Gazette 2004, No. 138)	3

RS Handbook	Status 06/09 Valid KTA standards (Status: 06/09)	Category
1200	<u>General, administration, organisation</u>	
1201	Requirements for the Operating Manual, 6/98	3
1202	Requirements for the Testing Manual, 6/84	3
1300	<u>Work Protection</u>	
1301.1	Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 1: Design, 11/84	3
1301.2	Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 2: Operation, 11/08	1
1400	<u>Quality Assurance</u>	
1401	General Requirements Regarding Quality Assurance, 6/96	3
1404	Documentation During the Construction and Operation of Nuclear Power Plants, 6/01	3
1408.1	Quality Assurance for Welding Filler Materials Weld Additives for Pressure and Activity Retaining Systems in Nuclear Power Plants; Part 1: Suitability Testing, 11/08	2
1408.2	Quality Assurance for Welding Filler Materials Weld Additives for Pressure and Activity Retaining Systems in Nuclear Power Plants; Part 2: Manufacturing, 11/08	2
1408.3	Quality Assurance for Welding Filler Materials Weld Additives for Pressure and Activity Retaining Systems in Nuclear Power Plants; Part 3: Processing, 11/08	2
1500	<u>Radiological Protection and Monitoring</u>	
1501	Stationary System for Monitoring Area Dose Rates within Nuclear Power Plants, 11/04	3
1502	Monitoring Radioactivity in the Inner Atmosphere Nuclear Power Plants, 11/05	3
(1502.2)	Monitoring Radioactivity in the Inner Atmosphere Nuclear Power Plants; Part 2: Nuclear Power Plants with High Temperature Reactor, 6/89	3
1503.1	Surveilling the Release of Gaseous and Aerosol-bound Radioactive Substances Part 1: Surveilling the Release of Radioactive Substances with the Stack Exhaust Air During Specified Normal Operation, 6/02	3
1503.2	Monitoring the Discharge of Gaseous and Aerosol-bound Radioactive Substances; Part 2: Monitoring the Stack Discharge of Radioactive Substances During Design Basis Accidents, 6/99	2
1503.3	Monitoring the Discharge of Gaseous and Aerosol-bound Radioactive Substances; Part 3: Monitoring the Non-stack Discharge of Radioactive Substances, 6/99	2
1504	Surveillance of the Discharge of Radioactive Materials in Liquid Effluents, 11/07	1
1505	Certification of Suitability of Radiation Measuring Equipment, 11/03	1

<b>RS Handbook</b>	<b>Status 06/09 Valid KTA standards (Status: 06/09)</b>	<b>Category</b>
(1506)	Measuring Local Dose Rates in Exclusion Areas of Nuclear Power Plants, 6/86 (16.11.2004: standard was withdrawn)	3
1507	Monitoring the Discharge of Gaseous, Aerosolbound and Liquid Radioactive Materials from Research Reactors, 6/98	3
1508	Instrumentation to Determine Atmospheric Diffusion of Radioactive Substances, 11/06	1
<u>2100</u>	<u>Plant, General</u>	
2101.1	Fire Protection in Nuclear Power Plants; Part 1: Basic Requirements, 12/00	3
2101.2	Fire Protection in Nuclear Power Plants; Part 2: Fire Protection of Structural Components, 12/00	3
2101.3	Fire Protection in Nuclear Power Plants; Part 3: Fire Protection of Mechanical and Electrical Components, 12/00	3
2103	Explosion Protection in Nuclear Power Plants with Light Water Reactors (General and Case-specific Requirements), 6/00	3
<u>2200</u>	<u>External Events</u>	
2201.1	Design of Nuclear Power Plants against Seismic Events; Part 1: Principles, 6/90	2
2201.2	Design of Nuclear Power Plants against Seismic Events; Part 2: Subsurface Materials (Soil and Rock), 6/90	2
2201.3	Design of Nuclear Power Plants against Seismic Events; Part 3: Design of Structural Components, 6/90	2
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	2
2201.5	Design of Nuclear Power Plants against Seismic Events; Part 5: Seismic Instrumentation, 6/96	2
2201.6	Design of Nuclear Power Plants against Seismic Events; Part 6: Post Seismic Measures, 6/92	2
2206	Design of Nuclear Power Plants against Lightning Effects, 6/00	2
2207	Flood Protection for Nuclear Power Plants, 11/04	3
<u>2500</u>	<u>Civil Engineering</u>	
2501	Structural Waterproofing in Nuclear Power Plants, 11/04	3
2502	Mechanical Design of Fuel Assembly Storage Pools in Nuclear Power Plants with Light Water Reactors, 6/90	2
<u>3000</u>	<u>Systems, General</u>	
<u>3100</u>	<u>Reactor Core and Reactor Control</u>	All 2
3101.1	Design of Reactor Cores of Pressurised Water and Boiling Water Reactors, Part 1: Principles of Thermohydraulic Design, 2/80	
3101.2	Design of Reactor Cores of Pressurised Water and Boiling Water Reactors, Part 2: Neutron-Physics Requirements for Design and Operation of the Reactor Core and Adjacent Systems, 12/87	

RS Handbook	Status 06/09 Valid KTA standards (Status: 06/09)	Category
(3102.1)	Reactor Core Design for High Temperature Gas-Cooled Reactors; Part 1: Calculation of the Material Properties of Helium, 6/78	
(3102.2)	Reactor Core Design for High Temperature Gas-Cooled Reactors; Part 2: Heat Transfer in Spherical Fuel Elements, 6/83	
(3102.3)	Reactor Core Design for High Temperature Gas-Cooled Reactors; Part 3: Loss of Pressure through Friction in Pebble Bed Cores, 3/81	
(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	
(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	
3103	Shutdown Systems of Light Water Reactors, 3/84	
3104	Determination of the Shutdown Reactivity, 10/79	
<u>3200</u>	<u>Primary and Secondary Circuits</u>	All 2
3201.1	Components of the Reactor Coolant Pressure Boundary of Light Water Reactors, Part 1: Materials and Product Forms, 6/98	
3201.2	Components of the Reactor Coolant Pressure Boundary of Light Water Reactors, Part 2: Design and Analysis, 6/96	
3201.3	Components of the Reactor Coolant Pressure Boundary of Light Water Reactors, Part 3: Manufacture, 11/07	
3201.4	Components of the Reactor Coolant Pressure Boundary of Light Water Reactors, Part 4: In-service Inspections and Operational Monitoring, 6/99	
3203	Monitoring of Radiation Embrittlement of Materials of the Reactor Pressure Vessel of Light Water Reactors, 6/01	
3204	Reactor Pressure Vessel Internals, 11/08	
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 of Light Water Reactors, 6/02	
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	
3205.3	Component Support Structures with Non-integral Connections, Part 3: Series-Production Standard Supports, 11/06	
3211.1	Pressure and Activity Retaining Components of Systems outside the Reactor Coolant Pressure Boundary, Part 1: Materials, 6/00	
3211.2	Pressure and Activity Retaining Components of Systems outside the Reactor Coolant Pressure Boundary, Part 2: Design and Analysis, 6/92	

RS Handbook	Status 06/09 Valid KTA standards (Status: 06/09)	Category
3211.3	Pressure and Activity Retaining Components of Systems outside the Reactor Coolant Pressure Boundary, Part 3: Manufacture, 11/03	
3211.4	Pressure and Activity Retaining Components of Systems Outside the Primary Circuit; Part 4: Inservice Inspections and Operational Monitoring, 6/96	
<u>3300</u>	<u>Heat Removal</u>	All 2
3301	Residual Heat Removal Systems of Light Water Reactors, 11/84	
3303	Heat Removal Systems for Fuel Assembly Storage Pools in Nuclear Power Plants with Light Water Reactors, 6/90	
<u>3400</u>	<u>Containment</u>	All 2
3401.1	Steel Containment Vessels, Part 1: Material and Product Forms, 9/88	
3401.2	Steel Containment Vessels, Part 2: Analysis and Design, 6/85	
3401.3	Steel Containment Vessels, Part 3: Manufacture, 11/86	
3401.4	Steel Containment Vessels, Part 4: Inservice Inspections, 6/91	
3402	Air Locks through the Containment Vessel of Nuclear Power Plants - Personnel Locks, 11/76	
3403	Cable Penetrations through the Reactor Containment Vessel, 10/80	
3404	Isolation of Operating System Pipes Penetrating the Containment Vessel in the Case of a Release of Radioactive Substances into the Containment Vessel, 11/08	
3405	Integral Leakage Rate Testing of the Containment Vessel with the Absolute Pressure Method, 2/79	
3407	Pipe Penetrations through the Reactor Containment Vessel, 6/91	
3409	Air-Locks for the Reactor Containment Vessel for Nuclear Power Plants - Material Locks, 6/79	
3413	Determination of Loads for the Design of a Full Pressure Containment Vessel against Plant-Internal Incidents, 6/89	
<u>3500</u>	<u>Instrumentation and Reactor Protection</u>	All 2
3501	Reactor Protection System and Monitoring Equipment of the Safety System, 6/85	
3502	Accident Measuring Systems, 6/99	
3503	Type Testing of Electrical Modules for the Reactor Protection System, 11/05	
3504	Electrical Drives of the Safety System in Nuclear Power Plants, 11/06	
3505	Type Testing of Measuring Transmitters and Transducers of the Reactor Protection System, 11/05	
3506	Tests and Inspections of the Instrumentation and Control Equipment of the Safety System of Nuclear Power Plants, 11/84	

RS Handbook	Status 06/09 Valid KTA standards (Status: 06/09)	Category
3507	Factory Tests, Post-repair Tests and Demonstration of Successful Service for the Instrumentation and Control Equipment of the Safety System, 06/02	
<u>3600</u>	<u>Activity Control and Activity Management</u>	
3601	Ventilation Systems in Nuclear Power Plants, 11/05	3
3602	Storage and Handling of Nuclear Fuel Assemblies, Control Rods and Neutron Sources in Nuclear Power Plants with Light Water Reactors, 11/03	1
3603	Facilities for Treating Radioactively Contaminated Water in Nuclear Power Plants, 6/91	1
3604	Storing, Handling and On-Site Transportation of Radioactive Substances (other than Fuel Elements) in Nuclear Power Plants, 11/05	1
3605	Treatment of Radioactively Contaminated Gases in Nuclear Power Plants with Light Water Reactors, 6/89	3
<u>3700</u>	<u>Energy and Media Supply</u>	
3701	General Requirements for the Electrical Power Supply in Nuclear Power Plants, 6/99	2
3702	Emergency Power Generation Facilities with Diesel-Generator Units in Nuclear Power Plants, 6/00	2
3703	Emergency Power Facilities with Batteries and AC/DC Converters in Nuclear Power Plants, 6/99	3
3704	Emergency Power Facilities with DC/AC Converters in Nuclear Power Plants, 6/99	2
3705	Switchgear Facilities, Transformers and Distribution Networks for the Electrical Power Supply of the Safety System in Nuclear Power Plants, 11/06	2
<u>3900</u>	<u>Other systems</u>	
3901	Communication Means for Nuclear Power Plants, 11/04	3
3902	Design of Lifting Equipment in Nuclear Power Plants, 6/99	1
3903	Inspection, Testing and Operation of Lifting Equipment in Nuclear Power Plants, 6/99	1
3904	Control Room, Remote Shutdown Station and Local Control Stations in Nuclear Power Plants, 11/07	2
3905	Load Attaching Points on Loads in Nuclear Power Plants, 6/99	1

## **10. Annex 3: Comments on application adapted to protection objectives or partial application of the BMI/BMU announcements and KTA standards in decommissioning procedures**

The BMI/BMU announcements and the KTA standards were evaluated to assess their applicability to decommissioning of nuclear facilities and were divided into the following categories:

Category 1: The rule is generally applicable and must therefore also be taken into account in decommissioning procedures.

Category 2: The rule is not relevant to decommissioning procedures. However, in case of construction measures that might be performed within the framework of decommissioning or significant changes of use it can be applied adapted to protection objectives in terms of Category 3.

Category 3: The rule is applicable after adaptation to the protection objectives or is partially applicable to decommissioning procedures, taking account of the changed, in many respects reduced, potential hazard and the modified requirements relative to construction and operation.

The listing given in the Handbook on Nuclear Safety and Radiation Protection /6/ was used. Annex 2 shows the classification of the rules into the stated categories.

### **3.1 Nuclear Power Plant Safety Criteria, Promulgation as of October 21, 1977 (Federal Gazette No. 206)**

Safety Criterion 2.10 concerns decommissioning and removal of nuclear power plants and requires preparation of decommissioning well in advance of cessation of operation.

### **3.4 Guidelines Concerning the Requirements for Safety Specifications for Nuclear Power Plants of 27 April 1976 (Joint Ministerial Gazette (GMBI.) 1976, No. 15, page 199)**

In accordance with KTA 1201 and 1202, the safety specifications are included in the operating manual/testing manual together with cross references. Following final shutdown of the facility the main points can be adapted to the altered condition of the facility during decommissioning. This adaptation can take place within the framework of the revision procedure or as part of the conversion of the Operating Manual to the "Dismantling Manual".

### **3.5 Checklist with Layout of a Standard Safety Analysis Report for Nuclear Power Plants with Pressurised Water Reactor or Boiling Water Reactor of 26 July 1976 (Joint Ministerial Gazette (GMBI.) 1976, No. 26, page 418)**

The aim of this list of reference items is to ensure that all of the hazards associated with operation of the facility and the planned safety measures are outlined.

Since the potential hazard of the facility alters and reduces significantly during decommissioning, particularly after removal of the nuclear fuel, the list of reference items can only be applied in a limited way in the decommissioning procedure.

If the existing list of reference items is to be used, then the following should be noted:

The data on the site and the facility should primarily include the changes which have occurred during the operating period and as a result of operation and, in particular, should characterise the radiological situation.

Information about the overall decommissioning project should be presented with the application for a license and possibly also in the safety report. This information should explain which application and licensing steps are to be used in the decommissioning procedure, taking account of the licensing situations outlined in § 7, para. 3 of the Atomic Energy Act (decommissioning, safe enclosure, dismantling of the facility or parts of a facility). This information should make it possible to assess, in particular, whether further procedures would be hampered or prevented and whether provision is made for an appropriate order of dismantling activities from the point of view of radiation protection.

The outlines of decommissioning measures should include the intended techniques, the sequence and the associated radiation protection and safety aspects, as well as the desired final status of the facility.

It is also important to outline what provisions have been made for the disposal of the spent fuel and radioactive substances and to detail physical protection measures and data on organisation and staffing.

### **3.7.1 Compilation of Information Required for Review Purposes under Licensing and Supervisory Procedures for Nuclear Power Plants of 20 October 1982 (Federal Gazette 1983, No. 6a)**

The summary of information for assessment is divided into sections oriented towards the individual systems and facilities. These sections are divided up according to different phases of manufacture, construction and commissioning of the facility or individual systems, essentially organised according to the chronological sequence of inspections forming part of the licensing and supervisory procedure.

Since the manufacture, construction and commissioning of systems only play a secondary role in the context of decommissioning, the summary of information for assessment cannot be applied to the decommissioning procedure of nuclear facilities or can only be applied in a very limited way.

In compiling the information for the decommissioning procedure, it should be noted that detailed information for the decommissioning procedure cannot be primarily related to components and their dismantling and subsequent treatment (as for construction and operation), but rather to the process and the stages of decommissioning and the associated work steps and aspects.

Detailed information about the dismantling and subsequent treatment of components as well as about other work projects and measures can be submitted and assessed as part of the accompanying controls.

The scope of the information which is to be submitted should at least correspond to that laid down in Section 3.2 of the guide.

### **3.7.2 Summary of the Data required for the Building Inspection of Nuclear Facilities of 6 November 1981 (Joint Ministerial Gazette (GMBI.) 1981, No. 33, page 518)**

This standard is to be applied for modifications to structural facilities, changes of use of rooms/buildings, for the construction of auxiliary equipment/buildings and load changes due to auxiliary equipment, which are associated with decommissioning.

In general, the level of detail of the information corresponds to the requirements of general building regulations.

### **3.9.2 Requirements for the Documentation at Nuclear Power Plants of 5 August 1982 (Joint Ministerial Gazette (GMBI.) 1982, page 546)**

In accordance with the regulations, the requirements also apply to the decommissioning procedure and are to be regarded in association with the "basic principles for documentation of technical data by the applicant/licensee for the construction, operation and decommissioning of nuclear power stations of 19 February 1988". The requirements deal with documentation of material and building inspections. They should only be applied to components of the activity containment whereby, in general, documentation category C should not be exceeded.

### **3.11 Safety Requirements for Nuclear Fuel Supply Facilities; April 1997 and June 2004 BMU RS III 3**

Safety requirement 2.15 concerns decommissioning and removal and requires preparation of decommissioning well in advance of cessation of operation.

### **3.15.1 Basic Recommendations for Emergency Preparedness in the Environment of Nuclear Facilities of 27 October 2008 (Joint Ministerial Gazette (GMBI.) 2008, No. 62/63, page 1278)**

### **3.15.2 Radiological Bases for Decisions on Measures for the Protection of the Population against Accidental Releases of Radionuclides of 27 October 2008 (Joint Ministerial Gazette (GMBI.) 2008, No. 62/63, page 1278) with Annex on the Use of Iodine Tablets for Blockage of the Thyroid in Case of a Nuclear Accident**

The Basic Recommendations (3.15.1) and the Radiological Bases (3.15.2) are to be applied. However, the extent of civil protection measures should be agreed with the competent authorities on the basis of the reduced potential risk and hazard still remaining in the actual facility.

The same also applies for guidelines issued by the *Länder*.

### **3.21 Interpretation of § 4, para. 4 sentence 1 no. 2e of the Radiation Protection Ordinance of 20 September 1979 (Joint Ministerial Gazette (GMBI.) 1979, page 631) (May still be relevant for older decommissioning licenses.)**

Clearance is based on the specifications of § 29 of the Radiation Protection Ordinance.

The basis of the exemption values for unrestricted clearance of substances is application of the 10 µSv/a criterion (see also Section 6.3 of the Guide).

**3.27 Guideline Relating to the Assurance of the Necessary Knowledge of the Persons otherwise Engaged in the Operation of Nuclear Power Plants of 30 November 2000 (Joint Ministerial Gazette (GMBI.) 2001, No. 8, page 153)**

The guideline is to be applied. The scope of knowledge to be demonstrated and the intervals for this demonstration can be adjusted to the altered potential hazard of the current status of the facility.

**3.31 Recommendations for the Planning of Emergency Control Measures by the Licensees of Nuclear Power Plants of 1977 (Joint Ministerial Gazette (GMBI.) 1977, No. 4, page 48), amended by announcement of 18 October 1977 (Joint Ministerial Gazette (GMBI.) 1977, No. 30, page 664) and the Guideline concerning Emission and Immission Monitoring of Nuclear Installations (REI) (Joint Ministerial Gazette (GMBI.) 1993, No. 29, page 502)**

The recommendations are generally applicable for nuclear facilities.

Once a facility is free from nuclear fuel, not all of the previous requirements are necessary and can be adjusted to the greatly reduced potential hazard.

**3.33.1 Guidelines for the Assessment of the Design of PWR Nuclear Power Plants against Incidents pursuant to Sec. 28, para. 3 of the Radiation Protection Ordinance (Incident Guidelines ) of 18 October 1983 (Federal Gazette 1983, No. 245a)**

The incidents and accidents which are to be considered are incorporated in the "Decommissioning Guide" and the accident calculation bases given in the incident guidelines are then to be applied for these. The rest of the incident guidelines are not applicable.

**3.43.1 Guideline for the Protection against Radiation of Personnel during the Execution of Maintenance Work in Nuclear Power plants with Light Water Reactors:  
Part I: The Precautionary Protective Measures to be taken during the Planning of the Plant – IWRS I of 10 July 1978 (Joint Ministerial Gazette (GMBI.) 1978, No. 28, page 418)**

This regulation is not applicable to the decommissioning procedure.

Thus, it can only be applied in keeping with the protection objectives associated with the construction of facilities necessary for decommissioning in the scope of § 7 (1) of the Atomic Energy Act.

**3.54.1 Recommendation for Remote Monitoring of Nuclear Power Plants of 12 August 2005 (Joint Ministerial Gazette (GMBI.) 2005, No. 51, page 1049)**

**3.54.2 Recommendation for Calculating the Fee as defined in § 5 of the AtKostV for the Remote Monitoring of Nuclear Power Plants of 21 January 1983 (Joint Ministerial Gazette (GMBI.) 1983, No. 8, page 146)**

When operation of the facility is ceased or the nuclear fuel is removed from it, the potential hazard is considerably reduced so that the number of parameters which require monitoring and possibly the measurement areas must be adjusted. The nuclear supervisory authority is responsible for deciding whether it is necessary to continue remote monitoring.

**3.57.1 Requirements Relating to the Physical Protection Service and Physical Protection Officers in Nuclear Installations and Facilities of 4 July 2008 (Joint Ministerial Gazette (GMBI.) 2008, No. 39, page 810)**

This guideline is to be applied - adjusted to the quantities of nuclear fuels or other radioactive substances still present in the facility.

**3.57.3 Guideline for Protecting LWR Nuclear Power Plants against Disruptive Actions or other Interference by Third Parties of 6 December 1995 (Joint Ministerial Gazette (GMBI.) 1996, No. 2, page 32) (without text)**

As a rule, the protection objectives listed in the guideline (theft of nuclear material, loss of primary coolant, residual heat removal) are no longer relevant in a shut down facility after the nuclear fuel has been removed. The protection objective is to prevent unnoticed theft and release of other radioactive substances. The guideline is therefore only to be applied in this sense.

**3.61 Guideline for the Technical Qualification of Radiation Protection Officers at Nuclear Power Plants and Other Facilities for Fission of Nuclear Fuels of 10 December 1990 (Joint Ministerial Gazette (GMBI.) 1991, No. 4, page 56)**

The guideline is also applicable to decommissioning and during the safe enclosure phase. In view of the range of duties, which would then be decreasing, reference can be made to Number 7, whereby exceptions from the requirements are possible.

For example, a university or polytechnic degree is not necessary, if adequate practical experience can be demonstrated.

At least every five years, the requisite knowledge in radiation protection must be updated by successful participation in a course recognised by the competent agency or other measures of further education recognised as suitable by the competent agency.

**3.62 Guideline Relating to Measures for the Protection of Facilities of the Nuclear Fuel Cycle and Other Nuclear Facilities Against Disturbances or Other Interference by Individuals Entitled to Access to the Facility of 28 January 1991 (Joint Ministerial Gazette (GMBI.) 1991, No. 9, page 228)**

Once the nuclear fuel has been removed, it is only necessary to take measures against the theft or release of other radioactive substances. As the decommissioning project progresses, the requirements of § 65 of the Radiation Protection Ordinance may be adequate.

**3.68 Security Measures for Protecting Nuclear Facilities with Category III Nuclear Material of 20 April 1993 (Joint Ministerial Gazette (GMBI.) 1993, No. 20, page 365) (without text)**

This guideline is to be applied in keeping with the quantities of nuclear fuels still present in the facility and as a function of the stage of decommissioning which has been reached.

## **Comments on the technical qualification guidelines**

**3.2 Guideline to the Proof of the Technical Qualification of Nuclear Power Plant Personnel of 14 April 1993 (Joint Ministerial Gazette (GMBI.) 1993, No. 20, page 358)**

**3.38 Guideline Relating to Programs for the Preservation of Technical Qualification of Responsible Shift Personnel at Nuclear Power Plants of 1 September 1993 (Joint Ministerial Gazette (GMBI.) 1993, No. 36, page 645)**

**3.39 Guideline for the Content of the Examination of Specialist Knowledge of Responsible Shift Personnel in Nuclear Power Plant of 23 April 1996 (Joint Ministerial Gazette (GMBI.) 1996, No. 26, page 555)**

The guidelines are only conditionally applicable since the requirements of the level of knowledge of nuclear power plant personnel during the decommissioning phases after removal of the nuclear fuel or in the event of a comparable reduction in the potential hazard in other facilities must be re-assessed from a qualitative as well as a quantitative point of view. This consideration is already taken into account by Guideline 3.2 Point 1.2 "Scope of application", by leaving the question of applicability to finally decommissioned reactor units to the licensing and supervisory authorities. For the purposes of practical application, the following should be considered:

1. As long as there are still nuclear fuels or other radioactive substances with comparable potential hazard in the facility, the same requirements of technical qualification apply as in the post-

operational phase. Examination of technical qualification of responsible shift personnel who are employed for the first time in nuclear power plants should concentrate primarily on

- legal principles,
- principles of nuclear physics,
- radiation protection,
- plant regulations,
- assuring sub-criticality in the fuel pool and reactor pressure vessel,
- ensuring removal of residual heat under the conditions of the post-operational phase and control of possible malfunctions or incidents,
- monitoring and retention/containment of radioactive substances, particularly in connection with the decontamination of activity-carrying systems.

Questions on electrical engineering, instrumentation and control and external systems should concentrate on the functions of the systems in achieving the above-mentioned protection objectives.

It is largely possible to forego training on the reactor simulator depending upon the operating sequences and malfunctions or incidents which may still occur in the nuclear power plant.

2. Once the nuclear fuel has been removed from the facility, the operational organisation may be changed so that some of the responsible functions listed under points 1.3.1 - 1.3.8 of Guideline 3.2 are no longer necessary (e.g. reactor operator). The scope of the demonstration of technical qualification for new responsible personnel who are to be appointed must be adjusted to take account of the new operational organisation, the greatly reduced potential hazard of the facility and the altered structure of duties (decommissioning and dismantling of systems, decontamination, radiation protection). Thus, it is possible to omit knowledge of the operating and accident behaviour of the facility as well as training on the reactor simulator and examination of technical knowledge in the sense of Guideline 3.2.

However, it is not possible to forego the demonstration of technical qualification.

The preservation of technical qualification is also to be adjusted to the changed boundary condition.

3. Once the nuclear fuels have been removed from the facility it is no longer necessary to include reactor physics, energy release and thermo-hydraulics in the demonstration of the technical qualification of the remaining responsible personnel or those newly appointed.

In view of the altered condition of the facility and the potential hazard, plant-specific knowledge can be concentrated on the following areas:

- buildings and equipment of buildings,
- ventilation systems and exhaust gas systems,
- pipework and pump systems,
- effluent systems,
- electrical installations,
- necessary control technology and auxiliary control panels,
- hazard warning system including instrumentation,
- radiological monitoring,
- necessary plant operation,
- access controls,
- fire monitoring,
- conventional monitoring,
- environmental monitoring.

Knowledge of the legal bases and administrative measures, in particular licensing notices and plant regulations, are also necessary to an extent which corresponds to the respective decommissioning phase. This also applies to the areas of radiation protection and industrial safety.

4. Subjects which must be included to a greater extent in staff training, demonstration of technical qualification and preservation of technical qualification are:

- specific dismantling know-how regarding dismantling methods, decontamination procedures, prevention of dispersion/ entrainment of radioactive substances,
- treatment of the substances (material recovery, conditioning of radioactive wastes, limit values and procedures on clearance measurements).

5. Guideline 3.61 continues to apply for the demonstration of technical qualification of radiation protection officers during the decommissioning procedure.

6. Once the nuclear fuels have been removed, a greater distinction can be made in the demonstration of technical qualification during the decommissioning procedure between the requirements of existing personnel and those made of newly appointed personnel. Existing operating personnel who have demonstrated and preserved technical knowledge in accordance with the applicable guidelines, should be predominantly trained in the new areas of industrial safety, fire

protection and radiation protection. Depending upon the decommissioning stage which has been reached, new operating personnel should be additionally trained in the areas listed in point 3.

7. The corresponding changes in the organisational plans, training and ongoing training schedules of the licensee require the approval of the competent nuclear authorities.

### **3.3 Guideline Relating to the Proof of the Technical Qualification of Research Reactor Personnel of 16 February 1994 (Joint Ministerial Gazette (GMBI.) 1994, No. 11, page 366)**

#### **3.53 Guideline for the Content of the Examination of Specialist Knowledge of Responsible Shift Personnel in Research Reactors of 14 November 1997 (Joint Ministerial Gazette (GMBI.) 1997, No. 42, page 794)**

These guidelines apply for the operation of research reactors with a thermal capacity of more than 300 kW. These guidelines refer neither directly nor indirectly to the decommissioning procedure. The following considerations should suffice for the demonstration of technical qualification:

1. As a rule, the staff belonging to the management chain and other members of the management (No. 2.3.1 and 1.3.2) are still present during the decommissioning work. Once the nuclear fuel has been removed from the facility, the requirements of specialist training and practical experience of this personnel (No. 2.1 of the guideline) can be reduced with respect to knowledge of energy release and thermo-hydraulics, reactor safety, the operational and accident behaviour of the research reactor and events which are significant from the point of view of safety.

2. Once the nuclear fuel has been removed, it is no longer necessary to carry out an examination of technical qualification in the sense of Guideline 3.3 with the contents of Guideline 3.53 for newly appointed responsible shift personnel.

3. Radiation protection officers must continue to be appointed taking account of Guideline 3.61. The question of the continuous presence of a radiation protection officer at the decommissioned facility can be decided during the course of the licensing procedure. It may be that, depending upon the advancement of the decommissioning work, in particular if shift operation is modified or abandoned, an on-call system may be adequate.

4. The competent nuclear authorities are to decide whether, depending upon the stage of decommissioning which has been reached, a shift leader, reactor operator and control station operator as well as training manager are still required as responsible persons.

5. The remaining demonstrations of technical qualification can be reduced in respect of the subjects of energy release and thermo-hydraulics as well as plant operation. Knowledge relating to decontamination procedures, dismantling methods and treatment of the substances as well as knowledge specifically relating to decommissioning in the areas of licensing and administrative measures should be added.

**3.71 Guideline relating to the Technical Qualification of Responsible Persons in Facilities for the Production of Fuel Elements for Nuclear Power Plants of 30 November 1995 (Joint Ministerial Gazette (GMBI.) 1996, No. 2, page 29)**

This guideline applies for the operation of facilities for manufacturing uranium dioxide and uranium/plutonium mixed oxide fuel elements for nuclear power plants. The guideline does not refer directly or indirectly to the decommissioning procedure. The following considerations should be sufficient for the demonstration of technical qualification:

As a rule, members of the management chain and other management staff (No. 2.1 and 2.2) are still present during the decommissioning work. Once the facility has been emptied of nuclear fuel, the requirements for the specialist training and practical experience of this personnel (No. 3.1 and 3.2 of the guideline) can be reduced in respect of knowledge relating to the specific operating and accident behaviour of the fabrication facilities.

Knowledge relating to dismantling methods, decontamination procedures and the treatment of the substances, as well as specific knowledge relating to decommissioning in the areas of licensing and administrative procedures, become more important.

**3.79 Provisions against Damage beyond Design-Basis Accidents, BMU Circular of 15 July 2003 RS I 3 – 10100/0**

As long as there is still nuclear fuel in the facility during decommissioning exceeding the masses or concentrations mentioned in § 2, para. 3 of the Atomic Energy Act, the requirements necessary to guarantee damage prevention must be fulfilled.

### **3.81 Fundamentals of Safety Management Systems in Nuclear Power Plants, BMU announcement of 29 June 2004 (Federal Gazette 2004, No. 138)**

The “Fundamentals for Safety Management Systems in Nuclear Power Plants” are to be applied to facilities under decommissioning correspondingly, taking account of the changed potential hazard relative to construction and the progress of decommissioning.

## **Comments on the KTA standards**

### **KTA Safety Standard 1201      Requirements for the Operating Manual**

The relevant parts of the standard are still applicable to the decommissioning procedure. To a large extent, the following parts are no longer relevant: Part 2: Operation of the overall facility, Part 3: Incidents and Part 4: Operation of systems.

Re: Part 1: To some extent, the plant regulations lose their justification during decommissioning and during the safe enclosure phase and are to be adjusted to the chosen operational organisation. An additional waste and residues regulation is recommended.

Re: Part 2: This part is to be reduced to important safety-related limit values for emissions of radioactive substances via the water and air pathway and to reporting criteria and official instructions which must be observed. The clearance criteria for radioactive substances must be incorporated.

Re: Part 3: The incidents which are to be considered must be adapted to the decommissioning project situation.

Re: Part 4: A basic description should be given not only of the operating systems but also of important additional systems, e.g. for decontamination and dismantling equipment. Actual detailed operating instructions shall not be part of the operating manual.

In general, the operating manual is to be adapted to the condition of the facility as the decommissioning process advances.

## **KTA Safety Standard 1202      Requirements for the Testing Manual**

This standard is also applicable during the decommissioning procedure. A testing manual is necessary as long as there are safety requirements of systems which are still operating during decommissioning work and of new systems which are to be installed during the course of decommissioning.

In general, the testing manual is to be adapted to the condition of the facility, as decommissioning advances. Simplifications (e.g. for the operating status) are possible.

## **KTA Safety Standard 1301.1      Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 1: Design**

This standard applies to the planning of buildings and systems within the controlled area and the part of the hygiene tract arranged outside it. It is only applicable for comparable plant modifications and for the construction of new parts of buildings and plant. Here consideration should be given to the possibly lower activity inventory. The aspects of incidents which need to be taken into account (Section 9) no longer have any relevance.

## **KTA Safety Standard 1401      General Requirements Regarding Quality Assurance**

This standard applies to quality assurance from planning to operation of fixed nuclear power plants and is to be applied in the decommissioning procedure, taking account of the respective activity inventory for such systems/components which serve to contain activity or monitor activity. The requirements of the organisational structure can be reduced relative to operation.

## **KTA Safety Standard 1404      Documentation During the Construction and Operation of Nuclear Power Plants**

This standard is essentially also applicable to the documentation which is compiled for the licensing and supervisory procedures for the decommissioning project.

This applies in particular to the principles laid down in KTA 1404.

Sections 3, 4 and 5 of the standards and the document retention times given in Table 9-1 are applicable to the decommissioning project.

The documentation should include a description of the changing status of the facility during the decommissioning process in order to allow the actual status of the facility to be assessed.

This documentation should show that the pre-conditions and legal principles are in place and have been fulfilled in a way which can be traced back and proven.

#### **KTA Safety Standard 1501      Stationary System for Monitoring Area Dose Rates within Nuclear Power Plants**

The measurement area and the requirements of the measuring devices in the event of accidents and the number of measuring devices are to be adjusted to the specific characteristics of the decommissioning procedure.

In keeping with the nature of decommissioning work, portable devices should predominantly be used for measuring local dose rates.

#### **KTA Safety Standard 1502      Monitoring Radioactivity in the Inner Atmosphere of Nuclear Power Plants**

##### **KTA Safety Standard 1502.2      Monitoring Radioactivity in the Inner Atmosphere of Nuclear Power Plants; Part 2: Nuclear Power Plants with High Temperature Reactor**

The requirements of the measuring devices in the event of accidents and the number of measuring devices are to be adapted to the specific characteristics of the decommissioning procedure. Monitoring can then be reduced to the radioactive substances which may be present. As a rule, portable devices are usually adequate when the facility is in the contained state.

#### **KTA Safety Standard 1503.1      Surveilling the Release of Gaseous and Aerosol-bound Radioactive Substances** **Part 1: Surveilling the Release of Radioactive Substances with the Stack Exhaust Air During Specified Normal Operation**

This standard is to be applied. Measurement can be restricted to the radioactive substances which are still present given the status of the facility. The requirements relating to redundancy and electricity supply can be adapted to the state of advancement of decommissioning.

**KTA Safety Standard 1506 Measuring Local Dose Rates in Exclusion Areas of Nuclear Power Plants (16.11.2004: standard was withdrawn)**

This standard is to be applied. Once the nuclear fuel has been removed, measurement of neutron radiation is no longer necessary.

**KTA Safety Standard 1507 Monitoring the Discharge of Gaseous, Aerosolbound and Liquid Radioactive Materials from Research Reactors**

Measurement can be restricted to the radioactive substances still present in keeping with the status of the facility.

**KTA Safety Standard 2101.1 Fire Protection in Nuclear Power Plants; Part 1: Basic Requirements**

**KTA Safety Standard 2101.2 Fire Protection in Nuclear Power Plants; Part 2: Fire Protection of Structural Components**

**KTA Safety Standard 2101.3 Fire Protection in Nuclear Power Plants; Part 3: Fire Protection of Mechanical and Electrical Components**

The requirements for protection of redundancies can be restricted.

**KTA Safety Standard 2103 Explosion Protection in Nuclear Power Plants with Light Water Reactors (General and Case-specific Requirements)**

The requirements of this standard are aimed at maintaining the function of important safety-related parts of the facility where there are explosion hazards. The basic principles (3) and the general requirements (4) are to be applied but restricted to the remaining parts of the facility which are still important to safety.

**KTA Safety Standard 2207 Flood Protection for Nuclear Power Plants**

As the decommissioning work advances, the protection objective is restricted to the containment of the radioactive substances.

As a rule, it is not necessary to take account of earthquakes in the load combinations (Section 6).

### **KTA Safety Standard 2501      Structural Waterproofing in Nuclear Power Plants**

This standard is to be applied in the decommissioning project where there are structural changes and new parts of structures. During decommissioning work the protection objective is restricted to the containment of the radioactive substances.

### **KTA Safety Standard 3601      Ventilation Systems in Nuclear Power Plants**

The general requirements of Section 3 are to be observed.

After removal of the nuclear fuel, Air Conditioning Class 2 given in Section 4 is adequate, since the important aspects are the protection objectives of radiation protection and the observance of specific atmospheric humidity (protection against corrosion).

The staggered under-pressure and air change rates are to be adapted to the requirements of the decommissioning process. As a rule, redundant design and emergency power connection are not necessary.

### **KTA Safety Standard 3605      Treatment of Radioactively Contaminated Gases in Nuclear Power Plants with Light Water Reactors**

This standard is to be applied to systems for the collection, guidance and treatment of contaminated radioactive off-gases in nuclear power plants with pressurised water reactor and in nuclear power plants with boiling water reactor. The standard is relevant for the treatment of the radioactively contaminated gases still present during decommissioning given the status of the facility.

### **KTA Safety Standard 3703      Emergency Power Facilities with Batteries and AC/DC Converters in Nuclear Power Plants**

In general, the requirements for energy supply units are no longer applicable. It is, however, necessary to have a secured energy supply to alarm systems (e.g. fire alarms) for which the requirements of the said KTA Safety Standard can be used.

## **KTA Safety Standard 3901      Communication Means for Nuclear Power Plants**

This standard is essentially to be applied in the decommissioning procedure. A redundant design of the alarm and personal tracing unit is not necessary. Permanently installed means of communication are not necessary for internal communications during operation of the containment phase.

## 11. Annex 4: Application documents for decommissioning, safe enclosure and dismantling of nuclear facilities in the Federal Republic of Germany

No.	Document	Reference	Content	Use/Remarks
1	Letter of application	§ 7, para. 3 AtG  § 2 AtVfV  § 6 AtVfV	<ul style="list-style-type: none"> <li>- Name and address of applicant</li> <li>- Type of license applied for</li> <li>- Type and scope of facility and of planned decommissioning measures</li> </ul>	nuclear licensing authority, authorised experts;  initiation of procedure; under certain circumstances announcement and public inspection
2	Safety report	§ 3, para. 1 subpara. 1 AtVfV  § 6 AtVfV	<ul style="list-style-type: none"> <li>a) Description and drawing of facility and decommissioning measures</li> <li>b) Description and explanation decommissioning plan, safety-related principles</li> <li>c) Provisions to fulfil §7(2) no. 3 of the AtG, radiation protection measures</li> <li>d) Description of the surrounding area and its composition</li> <li>e) § 47 Radiation Protection Ordinance, § 50 Radiation Protection Ordinance)</li> <li>f) Consequences of direct radiation and releases of radioactive substances</li> </ul>	nuclear licensing authority, authorised experts;  especially for third parties under certain circumstances public inspection g; no commercial secrets
3	Supplementary plans, drawings and descriptions of the facility and the planned decommissioning techniques and procedures	§ 3, para. 1 subpara. 2 AtVfV	<p>If required or requested by the nuclear licensing authority, the specific issues in the safety report are supplemented by explanatory reports.</p> <ul style="list-style-type: none"> <li>- Explanatory report on systems and equipment which are to be decommissioned, modified or newly constructed</li> <li>- Documentation of the status of the facility</li> <li>- Radiological (activity inventory, local dose rates, contamination of surfaces and rooms, quantities of wastes)</li> <li>- By mass</li> <li>- Explanatory reports (where applicable) concerning: <ul style="list-style-type: none"> <li>- Structural measures</li> <li>- Mechanical Measures</li> <li>- Ventilation measures</li> <li>- Instrumentation and control measures</li> <li>- Electrical measures</li> <li>- Administrative or organisational measures</li> </ul> </li> </ul>	nuclear licensing authority, authorised experts;  commercial secrets to be identified as such

No.	Document	Reference	Content	Use/Remarks
4	Report on physical protection	§ 3, para. 1 subpara. 3 AtVfV § 7, para. 2 subpara. 5 AtG	Details of measures in the event of interference by third parties, responsibilities	nuclear licensing authority, authorised experts; separate submission; classified document
5	Reliability and technical qualification	§ 3, para. 1 subpara. 4 AtVfV § 7, para. 2 subpara. 1 AtG	Appointment of responsible persons, demonstration of technical qualification as defined in or in association with BMU guideline on specialist knowledge of nuclear power plant personnel; details on reliability	nuclear licensing authority, authorised experts; commercial secrets to be identified as such
6	Know-how and reliability	§ 3, para. 1 subpara.5 AtVfV § 7, para. 2 subpara. 2 AtG AtZüV	Necessary know-how and procedure for training for other personnel involved; details on reliability; equally applicable to external personnel	nuclear licensing authority, authorised experts; commercial secrets to be identified as such
7	List of measures relevant for safety	§ 3, para. 1 subpara. 6 AtVfV § 7, para. 2 subpara. 3 AtG § 50 StrlSchV	List of measures for management of incidents and accidents (safety specifications)	nuclear licensing authority, authorised experts; commercial secrets to be identified as such
8	Financial security measures	§ 3, para. 1 subpara. 7 AtVfV § 7, para. 2 subpara. 4 AtG § 12 AtDeckV	Proposals for fulfilling compensation obligations	nuclear licensing authority, authorised experts; commercial secrets to be identified as such
9	Radioactive residues	§ 3, para. 1 subpara. 8 AtVfV § 9a AtG	Description of the arising radioactive residues; measures for avoiding radioactive residues, for non-detrimental utilisation and disposal as waste	nuclear licensing authority, authorised experts; commercial secrets to be identified as such
10	Overriding public interests, environmental impact	§ 3, para. 1 subpara. 9 AtVfV § 7, para. 2 subpara. 6 AtG	List of proposed measures for protecting water, air and ground; details on other environmental consequences	nuclear licensing authority with the assistance of other relevant authorities, authorised experts; commercial secrets to be identified as such
11	Documents for environmental impact assessment (EIA)	§§ 2a, 7, para. 4 AtG §§ 1a, 3, 4, 19b AtVfV §§ 3, 3c UVPG § 6 UVPG §§ 8 ff. AtVfV § 6 AtVfV	Determination of significant environmental effects; presentation of procedural alternatives;  documents of the project developer; Hearing	in the case of public involvement and thus projects subject to environmental impact assessments

No.	Document	Reference	Content	Use/Remarks
12	Brief description	§ 3, para. 4 AtVfV § 6 AtVfV	Summary description according to safety report	nuclear licensing authority, authorised experts, third parties; if public involvement is necessary: public inspection; no commercial secrets
13	List of documents submitted	§ 3, para. 4 AtVfV	Listing; documents containing commercial secrets should be identified	nuclear licensing authority, authorised experts
14	Adaptation of operating manual and testing manual		Revision in keeping with new status of the facility; dismantling manual	nuclear licensing authority, authorised experts
15	Details of licensing decisions, conditions and permits to be suspended or modified		List with explanations or justification	nuclear licensing authority, authorised experts; commercial secrets to be identified as such
16	Documents required by building regulations	<i>Land</i> building code	Details of building and demolition activities associated with decommissioning	nuclear licensing authority, if applicable building inspectorate
17	Documents required by the Federal Immission Control Act (BImSchG)	§ 7, para. 2 subpara. 6 AtG and § 8 AtG	Data on facilities requiring licensing in accordance with the terms of §4 of the Federal Immission Control Act	nuclear licensing authority, competent <i>Land</i> authority for protection against immissions
18	Documents relating to water rights	Federal Water Act (WHG) § 7, para. 2 subpara. 6 AtG	Application for water license and permit, if modification required	Water authorities, nuclear licensing authority