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

as at 23 June 2016

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Contents

1 Introduction
2 Framework
  2.1 Principles
  2.2 Legal regulations
  2.3 Guidance instruments
  2.4 International regulations, standards and
     recommendations
3 Decommissioning planning and application
documents
  3.1 Decommissioning strategies
  3.2 Decommissioning concept
  3.3 Post-operational phase
  3.4 Application documents
  3.5 Safety considerations
  3.6 Definition of decontamination and dismantling
     techniques
  3.7 Staffing provisions
  3.8 Financial security
4 Licensing procedures
  4.1 Checking the licensing prerequisites
  4.2 Transition from operating licence to decommissioning
     licence
  4.3 Licensing procedure with several steps
  4.4 Environmental impact assessment and involvement
     of third parties
5 Supervision
  5.1 Work permits for decommissioning activities
  5.2 Documentation
6 Handling of radioactive and non-radioactive materials
   from decommissioning
  6.1 Release from regulatory control
  6.2 Measurement methods and sampling
  6.3 Clearance
  6.4 Removal
  6.5 Treatment and storage of radioactive substances
7 References
8 Annex 1: Definition of terms
9 Annex 2: Classification of the BMI/BMUB and KTA
   standards in terms of their applicability to
decommissioning procedures
10 Annex 3: Comments on application adapted to
     protection goals or partial application of the
     BMI/BMUB announcements and KTA safety
     standards in decommissioning procedures
11 Annex 4: Application documents for
   decommissioning, safe enclosure and dismantling of
   nuclear facilities in the Federal Republic of Germany
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 licences which have so far been issued under the terms of § 7(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 Federation and the Länder to ensure that decommissioning procedures are carried out appropriately, and
- to harmonise the existing views and procedures where possible.

Accordingly, 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 AtG in respect of the application of the non-statutory guidance instruments, 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. For research reactors and nuclear fuel cycle facilities, there may be differing conditions that are to be considered specifically for these facilities.

Annex 1 of the guide contains definitions of the key terms used in this guide. So, the term “decommissioning” is generally used in this guide both as single word and as compound term (e.g. decommissioning procedure) in the wider sense as generic term for all activities aimed at decommissioning (including safe enclosure and dismantling). This is in line with technical language and international usage. In the AtG, 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 AtG or if decommissioning, safe enclosure and dismantling are mentioned together.

This revised guide replaces the guide to the decommissioning, safe enclosure and dismantling of facilities or parts thereof as defined in § 7 AtG of 12 August 2009 (Federal Gazette (BGBl.) No. 162a of 28 October 2009) 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

Based on the protection goals of § 1 AtG, also in accordance with international recommendations /1/, /2/, /3/, the ultimate objective of all decommissioning measures should be the release of nuclear facilities from regulatory control. The decommissioning measures can also be terminated by conversion of the remaining part of the facility not yet cleared to another use licensed under nuclear or radiation protection law.

According to § 7(3) AtG, decommissioning, safe enclosure and dismantling of facilities or parts thereof are subject to licensing. For the release of radioactive substances produced by it and of movable goods, buildings, soil areas, facilities or parts thereof, which are activated or contaminated, from supervision under nuclear or radiation protection law, 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 thereof which are covered by a licence under § 7(1) AtG may be released without clearance according to § 29 StrlSchV if they do not come from the controlled area and are not contaminated or activated. A soil area may also be released (removed) from regulatory control without clearance according to § 29 StrlSchV 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 assessment of decommissioning measures in terms of safety is the potential hazard which is determined by the inventory of radioactive substances, the technical condition of the facility and its safety-related design. 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 provisions set out in §§ 46, 47, 50 StrlSchV and all other protective requirements of the StrlSchV. For accident analyses it is necessary to postulate event sequences that can be derived from the type, quantity and distribution of remaining radioactive substances together with the decommissioning activities applied for.

As long as there is still nuclear fuel in the facility during decommissioning exceeding the masses or concentrations defined in § 2(5) AtG, the requirements that are necessary to guarantee safety must continue to be fulfilled.

2.2 Legal regulations

The legal bases for decommissioning procedures are the Atomic Energy Act as well as the associated ordinances and general administrative provisions. There exist no other laws and regulations specific to the decommissioning procedure. The non-statutory guidance instruments also 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 Utilisation of Atomic Energy and the Protection against its Hazards (Atomic Energy Act) as

* see Chapter 7 “References” (respectively)
relates specifically to decommissioning for facilities as the same time, it is the only provision of the AtG which enclosure or dismantling of the facility or parts thereof. At the same time, it is the only provision of the AtG which relates specifically to decommissioning for facilities as defined in § 7(1) AtG.

Regarding the utilisation of radioactive residues as well as radioactive components which have been dismantled or removed and the management of radioactive waste, the basic provisions of § 9a AtG apply.

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

§ 7(1a) AtG specifies when the authorisation to operate a facility for the fission of nuclear fuel for the commercial generation of electricity expires at the latest.

Act on the Environmental Impact Assessment (UVPG)


Appendix 1 No. 11 UVPG specifies for which nuclear facilities it is mandatory to conduct an environmental impact assessment (EIA – German abbreviation: UVP).

Nuclear Licensing Procedure Ordinance (AtLVV)


The licensing procedure for decommissioning, safe enclosure and dismantling of nuclear facilities or parts thereof according to § 7 AtG is based on the AtLVV. It contains provisions which are specific to decommissioning, in particular for the involvement of third parties and for the EIA in §§ 4(4) and 19b AtLVV.

In order to check the other provisions related to the project that are subject to public law, reference is made to § 14 AtLVV and for projects subject to an EIA also to § 14a AtLVV.

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

Radiation Protection Ordinance (StrlSchV)

Ordinance on the Protection against Damage and Injuries Caused by Ionizing Radiation (Radiation Protection Ordinance – StrlSchV) of 20 July 2001 (Federal Law Gazette (BGBl.) I, page 1714), last amended by Article 5 of the Ordinance of 27 April 2016 (Federal Law Gazette (BGBl.) I, page 980)

The StrlSchV is of particular relevance for the decommissioning measures. Its provisions contained in § 2(1)1.c) apply to decommissioning, safe enclosure of a facility and the dismantling of a facility or parts thereof as defined in § 7 AtG, 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 StrlSchV regulates clearance unless existing regulations are maintained according to the transitional provisions of § 117(10) StrlSchV.

Nuclear Financial Security Ordinance (AtDeckV)


§ 12 AtDeckV represents a provision specific to decommissioning. If there are no more nuclear fuels in the facility, the standard limit is to be determined according to the values given in the column for unsealed radioactive substances in Annex 2 AtDeckV. According to Annex 2 AtDeckV, the standard limit can be determined by means of the residual activity in the facility as multiple of the exemption levels defined in Appendix III, Table 1, Column 2 StrlSchV.

Other nuclear ordinances

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

- Cost Ordinance under the Atomic Energy Act (AtKostV)
- 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 – AtSMV) of 14 October 1992 (Federal Law Gazette (BGBl.) I, page 1766), last amended by Article 1 of the Ordinance of 8 June 2010 (Federal Law Gazette (BGBl.) I, page 755)
- 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 – AtZüV) of 1 July 1999 (Federal Law Gazette (BGBl.) I, page 1525), last amended by Article 1 of the Ordinance of 22 June 2010 (Federal Law Gazette (BGBl.) I, page 825)

Reference is made to the Repository Prepayment Ordinance (EndlagerVlV).

2.3 Guidance instruments

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, Building and Nuclear Safety (BMUB) (formerly: 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),
- decisions of the of the Länder Committee for Nuclear Energy (LAA) – General Committee – were primarily prepared with regard to the construction and operation of these facilities.

Announcements of the BMUB, the formerly competent BMI and KTA standards

The announcements of the BMUB, the formerly competent BMI and the KTA safety 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 is therefore also to be taken into account for decommissioning procedures.

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

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

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

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

Where there are no special nuclear safety requirements or requirements in terms of radiation protection, 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 permitted in individual cases if the necessary level of safety can be guaranteed to a comparable degree in another way.

Recommendations of the ESK

The following ESK recommendation is generally relevant in terms of decommissioning:

- Guidelines for the decommissioning of nuclear facilities, recommendation of the Nuclear Waste Management Commission of 16 March 2015 /20/

Furthermore, the ESK prepared a recommendation “Guidelines for the storage of radioactive waste with negligible heat generation” in a revised version of 10 June 2013 /13 /, which is also applicable with regard to radioactive waste from the dismantling of nuclear facilities. This recommendation was recommended for application by decision of the Länder Committee for Nuclear Energy (LAA) – General Committee – on 13/14 June 2013.

Other statements given refer to actual decommissioning procedures.

Recommendations of the RSK

General recommendations on decommissioning procedures of nuclear facilities are not available at present. Statements given so far refer to actual decommissioning procedures. With the establishment of the ESK on 12 June 2008, the decommissioning of nuclear facilities has been included as a subject for consultations in the statutes of the ESK.

Recommendations of the SSK

General recommendations on decommissioning procedures of nuclear facilities are not available at present. Statements given so far 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.

Decisions of the Länder Committee for Nuclear Energy (LAA) – General Committee –

The following decision of the Länder Committee for Nuclear Energy (LAA) – General Committee – specifies the procedure of federal regulatory review and assessment and the necessary documents as part of the procedure for granting of a decommissioning licence:

- Decision at the meeting of the Länder Committee for Nuclear Energy (LAA) – General Committee – on 3/4 July 2014 in Potsdam: federal regulatory review and assessment of licences for decommissioning and dismantling

2.4 International regulations, standards and recommendations


The obligations under Article 37 of the Euratom Treaty are binding. The rules of the Espoo Convention and the Paris Convention have been transposed into national law.
Moreover, the convention on spent fuel and nuclear waste management as well as the safety standards of the International Atomic Energy Agency (IAEA) in Vienna serve as guidance.

Euratom Treaty

Article 37 of the Euratom Treaty stipulates that for any plan for the disposal of radioactive material in whatever form, “general data” shall be submitted to the European Commission from which potential impacts on the territory of other states of the European Union can be determined. Annex 3 of the Commission Recommendation of 11 October 2010 on the application of Article 37 of the Euratom Treaty /18/ stipulates that for the dismantling of nuclear reactors, mixed-oxide fuel fabrication plants and reprocessing plants (except research reactors whose maximum power does not exceed 50 MW continuous thermal load) general data shall be given on the site and its surroundings, on the installation, on the discharge of airborne radioactive effluents during normal operation, on the discharge of liquid radioactive effluents during normal operation, on the removal of solid radioactive waste from the installation (also including the specified clearance levels, material types and amounts), on unplanned releases of radioactive effluents, on emergency plans and, finally, on environmental monitoring. Usually (depending on the radiation exposure in the vicinity of the plant) data on effective doses in other Member States affected are also to be provided. 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 licence for the discharge of radioactive substances.

Espoo Convention

Germany is a party to the international “Convention on Environmental Impact Assessment in a Transboundary Context” of 25 February 1991, the so-called Espoo Convention, as well as its two amendments. Accordingly, the authorities and the public of other potentially affected neighbouring states shall be involved prior to approval of the project within the framework of a transboundary environmental impact assessment if the project may have transboundary environmental effects.

Paris Convention

The Paris Convention of 29 July 1960 (later supplemented by protocols) in force in Germany and most Western European countries, contains substantive rules on civil liability of the operator of a nuclear facility for damage caused by a nuclear incident.

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 at the IAEA 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 at the national level /14/. 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 in terms of 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 transposes them, where required, into national law. The following IAEA safety standards are relevant in terms of decommissioning:

- Safety Fundamentals on the Principles of Radioactive Waste Management /4/,
- General Safety Requirement Part 5: Predisposal Management of Radioactive Waste /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/,
- General Safety Requirement Part 6: Decommissioning of Facilities /15/,
- Safety Guide on Release of Sites from Regulatory Control on Termination of Practices /16/,
- Safety Guide on Storage of Radioactive Waste /17/,

3 Decommissioning planning and application documents

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

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

According to § 7(3) AIG, the decommissioning of a facility as defined in § 7(1) AIG, the safe enclosure of the definitely decommissioned facility and the dismantling of the facility or parts thereof require licensing without further specifying the situations in which a licence must be applied for. In the licensing practice so far, the necessary licences were mainly granted on a step-wise basis. Within the framework of the procedure for the first licence, 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 licence will interfere with or prevent other measures and whether an appropriate order of the dismantling measures is provided (§ 19b(1) AtVfV). At the same time, an environmental impact assessment of the entire decommissioning project is to be carried out for the first licence (§ 19b(3) AtVfV).

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

3.1 Decommissioning strategies

According to § 7(3) AtG, the following decommissioning strategies are available in Germany:

- Dismantling …
  - Immediate dismantling of the facility or parts thereof and release from regulatory control

- Safe enclosure …
  - Transfer of the facility to a state with low maintenance requirements for a longer period and postponement of dismantling and release from regulatory control to a later period

The AtG and the German legal regulations consider the decommissioning strategies “immediate dismantling” and “safe enclosure” to be equivalent. For safe enclosure, transfer of knowledge of staff with operating experience to staff for deferred dismantling must be ensured by documentation and retention of information.

The decommissioning licence has to specify kind and scope of the safety reviews for the facility to be conducted during safe enclosure at regular intervals (at least every ten years).

3.2 Decommissioning concept

For the preparation of decommissioning, requirement 3.11 (7) of the safety requirements for nuclear power plants /7/ stipulates the following:

The condition of nuclear power plants shall be such that they can be decommissioned in compliance with the radiation protection regulations. A concept shall exist for their removal after final decommissioning in compliance with the radiation protection regulation."

Equivalent requirements are laid down in 2.15 of the safety requirements for nuclear fuel supply facilities /22/.

This requires considering the issues of decommissioning and removal.

The operating licences for nuclear power plants generally 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 as well as data relevant for 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 provisions can be used for planning the decommissioning measures.

3.3 Post-operational phase

The safety status of the facility in the post-operational phase is to be assessed. In a checklist for carrying out an assessment of the current safety status of the facility for the post-operational phase /21/ it is shown which aspects are important for the assessment for the post-operational phase and should be considered in it.

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, 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 licence or do not represent significant changes (i.e. they can be carried out in accordance with the operating manual as insignificant changes). This includes, for example (see also the ESK guidelines for the decommissioning of nuclear facilities /20/),

- Removal of fuel assemblies or nuclear fuel as early as possible,
- Decontamination of the facility and systems,
- Taking material samples from systems and components (e.g. for the purpose of a radiological characterisation of the facility) required for the licence application for decommissioning,
- Taking inventory of hazardous (e.g. flammable, toxic, water-endangering) substances,
- Adaptation of the operating procedures,
- Utilisation of radioactive substances and removal of radioactive waste from the operational phase,
- Taking out of service and isolation of systems and installations no longer required, and
- Creation of open spaces and of internal transport routes.

3.4 Application documents

According to § 3(1) AtVfV, the application for granting of a licence according to § 7(3) AtG shall be accompanied by all documents needed to examine the licensing prerequisites in analogous application of § 7(2) AtG.

According to § 19b(1) 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 thereof to outline in what application and licensing steps the decommissioning procedure should take place, taking into account the situations in which a licence must be applied for according to § 7(3) AtG. This information should provide a basis for assessing, in particular, if other measures are interfered with or prevented and whether the dismantling measures are planned in an appropriate order also in terms of radiation protection. In the case of first application, § 19b(3) AtVfV specifies that the EIA extends to all measures planned for decommissioning, safe enclosure or dismantling of the facility or parts thereof (see Section 4.4).

For the decommissioning of nuclear facilities, this means that, regarding the technical content of the application documents, the following details are required in particular:

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 the decommissioning procedure

c) Description of the decommissioning measures applied for and of the entire decommissioning procedure planned as well as the demonstration that later dismantling will not be interfered with or prevented by the measures applied
d) Description of the planned decommissioning and dismantling techniques such as decontamination methods, cutting techniques and remotely controlled dismantling techniques.

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 for the phase during which this is being achieved.

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

v) Description of the physical-technical state of the facility in safe enclosure.

w) Planned monitoring and maintenance programme.

x) Description of existing or new systems for maintaining safe enclosure, e.g. barriers, ventilation, condensate removal, instrumented monitoring.

3.5 Safety considerations

The potential hazard of a nuclear facility under decommissioning is significantly reduced compared to power operation.

After removal of the fuel assemblies, the hazard potential mainly depends on the activity inventory and the possibilities of a release of radionuclides associated with decommissioning.

If there are still fuel assemblies in the nuclear facility, it is to be shown for planned dismantling measures that these will have no retroactive effects on the safe operation of systems and components necessary for compliance with the protection goals.

If there are other nuclear facilities at the site, the possible impacts on the other nuclear facilities are to be shown for dismantling measures and it must be demonstrated that there is no reason to suspect any inadmissible impacts on them.

In the case of facilities for the fission of nuclear fuel, a considerable reduction of the activity inventory is already achieved solely by removal of the fuel assemblies. The possibility of criticality is then excluded. Activation activity is safely contained in the activated components themselves. The contamination 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 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(3) AtG, 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 accidents, as defined in § 50(2) in conjunction with (1) StrlSchV. The licensing authority determines the kind and scope of the protective measures, taking into account the individual case, particularly the potential hazard of the facility and the probability of the occurrence of an accident. According to § 50(4) StrlSchV, the protection goals for accident precautions shall be specified by general administrative provisions. Until their entry into force, an accident planning value of 50 mSv is applicable for the effective dose as defined in § 117(18) StrlSchV.

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 to be modified.

f) Safety studies including accident analyses, taking into account the provisions of § 50 StrlSchV for the planned decommissioning activities and the operation of new or modified systems and with a view to fulfilling the minimisation requirement in § 6(2) StrlSchV and other radiation protection principles and radiation protection provisions for workers, the environment and the public. It must be demonstrated how the necessary protection against damage is ensured.

g) Estimation and evaluation of the radioactive inventory and, where applicable, of dangerous substances and supporting documents.

h) Description and classification of the radioactive waste types 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 waste water, 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 staff responsible and the maintenance of technical qualification and necessary know-how of persons otherwise engaged.

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) 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(2) AtVfV):

t) A survey of the most important alternative technological processes examined by the applicant, including a statement of the main reasons for the selection of a procedure.

u) References to difficulties encountered in compiling the data for the environmental impact assessment.
Some of the safety considerations (accident analyses) already made for the construction and operation of the facility under decommissioning can continue to be referred to. As long as there is still nuclear fuel in the facility during decommissioning exceeding the masses or concentrations mentioned in § 2(3) AtG, all necessary safety precautions must continue to be observed and must be included in the corresponding considerations.

Many decommissioning activities, particularly those for the dismantling of parts of facilities, involve very similar techniques to those of the maintenance procedures and modification measures already licensed for operation. Thus, special safety considerations or accident analyses are only required if the state 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 assessed in terms of safety in decommissioning procedures on a case-by-case basis (see also the ESK guidelines for the decommissioning of nuclear facilities /20/):

a) Internal hazards:
   - Internal fire
   - Leakage from vessels or systems
   - Internal flooding
   - Drop and impact of heavy loads
   - Collision of vehicles at the site with structures, systems and components important for safety and events during transport processes
   - Interaction with other facilities at the site
   - Internal explosions
   - Chemical hazards
   - Failure of supply systems (including energy supply) or monitoring systems, ventilations systems and installations for the retention of radioactive substances

b) External hazards
   Natural hazards, e.g.:
   - Extreme meteorological conditions
   - Flooding
   - Biological hazards
   - External fire (e.g. forest fire)
   - Earthquakes

   Man-made hazards, e.g.:
   - Aircraft crash
   - External explosion
   - Intrusion of hazardous substances
   - External fire

If there are still fuel assemblies in the nuclear facility, the following event categories (based on the safety requirements for nuclear power plants /7/) are also relevant:
   - Reduced heat removal from the spent fuel pool
   - Loss of coolant from the spent fuel pool
   - Reactivity changes in the spent fuel pool and criticality accident
   - Events during handling and storage of fuel assemblies

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

The barrier system in place 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.

After removal of the fuel assemblies from the facility, nearly all internal accidents can be assigned to the "basic types" fire, leakage from vessels or systems containing radioactive fluid and drop of loads. Generally, the 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.

3.6 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.

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

The decontamination methods are chosen in the context of the following aspects:

a) Aspect of radiation protection
   - Avoidance of unnecessary radiation exposure
   - Dose reduction
   - Removal of contamination to increase the admissible time individuals can stay in working areas or to achieve appropriate conditions for carrying out decommissioning work

b) Aspect of utilisation of radioactive substances
   - Non-detrimental utilisation of radioactive substances or parts of the facility as far as possible
   - Reduction in the volume of radioactive substances to be stored in storage facilities until disposal
   - Minimisation of secondary waste generated during decontamination and dismantling
3.7 Staffing provisions

The requirements for staffing provisions are both applicable to own staff and external staff. The applicant/operator must ensure that an adequate number of staff with the required qualification and knowledge is available in all phases and periods of the decommissioning procedure until release from regulatory control. The use of own staff as responsible persons in terms of the technical qualification guideline has proved itself regarding the maintenance of continuity of staff. According to § 7(2)1 AtG, the persons who are responsible must have the necessary technical qualification, and the organisational structures necessary to ensure safety must be in place. Persons otherwise engaged in the decommissioning measures must possess the necessary knowledge as defined in § 7(2)2 AtG. In addition, it must be ensured that in all cases of personnel changes, also in the event of a possible change in the licence holder, all of the documentation relating to the actual condition 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 own staff and external staff, the regulations of the AIZüV apply.

3.8 Financial security

Regulations on the amounts of coverage are laid down in §§ 7 et seq. AtDeckV. As long as there is nuclear fuel in the facility, the amount of coverage is calculated according to § 9 AtDeckV. If there is no more nuclear fuel in the facility, a lower amount of coverage is to be defined according to § 12 AtDeckV.

A condition for application of § 12 AtDeckV is that only the activated and contaminated parts as well as radioactive substances, if any, remain in the facility for testing purposes. Where, due to the circumstances of the individual case, the assessment of activity necessarily involves undue expense or is not possible at all, the administrative authority may reduce the amount of coverage to 5 % of the coverage last determined prior to the decommissioning or made non-operational in any other way.

The licence holder has to provide proof of the specified amount of coverage.

4 Licensing procedures

The permissions and conditions of a licence for decommissioning, safe enclosure or dismantling of facilities as defined in § 7(3) AtG are specified on the basis of the licence application applying § 7(2) AtG accordingly.

Depending on the type of application, the decommissioning measures for nuclear facilities can be regulated by a single licence but can also be divided into steps which are licensed separately with their own licences as defined in § 7(3) AtG. 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 delimitable steps. A comprehensive decommissioning licence 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 licensing prerequisites

The licence may only be granted if the licensing prerequisites defined in § 7(3) in conjunction with (2) AtG, to be applied as appropriate, are fulfilled or if their fulfilment can be ensured by ancillary conditions (§ 15(2) sentence 1 AtVfV) and the other provisions under public law have been observed (§ 14 AtVfV). Completeness of the application documents as defined in § 3 AtVfV and their assignment to the licensing prerequisites can be checked using the list given in Annex 4. In addition,
Annex 4 refers to documents of other legal provisions which, due to the concentration effect of the nuclear licence (§ 8(2) AtG) must be checked or considered in the nuclear licensing procedure according to § 14 AtVfV.

4.2 Transition from operating licence to decommissioning licence

If the operating licence is suspended upon issuance of the decommissioning licence, then the conditions and regulations of the operating licence which continue to be required must be incorporated in the decommissioning licence.

If the operating licence is not completely suspended upon issuance of the decommissioning licence, then the unaltered conditions and regulations of the operating licence will remain in force.

During the transition from the operating to the decommissioning licence, there must be no gaps in terms of the required conditions and regulations for ensuring the safety of the facility. It must be ensured at all times that the conditions and regulations are clear and complete.

4.3 Licensing procedure with several steps

In case of a licensing procedure with several steps, the decommissioning procedure can be divided into individual steps which are applied for and licensed separately.

Decommissioning, safe enclosure, dismantling of the facility and parts thereof constitute separate situations in which a licence must be applied for according to § 7(3) AtG.

According to § 19b(1) AtVfV, the documents to be enclosed with the first application for a licence pursuant to § 7(3) AtG shall also include specifications on all measures planned for decommissioning, safe enclosure or dismantling. This information should provide a basis for assessing, in particular, whether the measures applied for interfere with or prevent other measures and whether the dismantling measures are planned in an appropriate order. This assessment, however, does not constitute a preliminary positive overall assessment with a corresponding linking function as it is required according to § 16(1) AtVfV for granting of partial licences for construction and operation.

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

Dividing up the decommissioning procedure facilitates the introduction of new technologies and the implementation of experience gained from previously completed phases. The assessment of the next step can also take place in parallel to the execution of the phase which has already been licensed. This approach may also result in a gain in time as regards the completion of the overall project.

With the separate licences according to § 7(3) AtG it is possible to define conditions according to which parts of the facility or ancillary installations which are no longer required in the decommissioning procedure for achieving the purposes outlined in § 1 AtG and which might be used elsewhere are released from regulatory control and thus the scope of the facility and also the limits of the controlled and supervised area according to the StrlSchV might be redefined.

This means that those parts of the facility not required for safety purposes (buildings, systems, components) which are not necessary for fulfilling the protection goals as defined in § 1 AtG and for safe possession of the facility (e.g. "inactive parts of the facility") can only be dismantled and removed upon receipt of a corresponding licence in so far as they are included in the scope specified in § 7(1) AtG.

Buildings that remain after dismantling of systems and components can be removed from regulatory control or cleared for unrestricted use according to § 29 StrlSchV, depending on whether the prerequisites are fulfilled. Buildings of a controlled area are always subject to regulatory control.

4.4 Environmental impact assessment and involvement of third parties

According to Appendix 1 No. 11 UVPG, an EIA is to 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(4) AtVfV, § 19b(2) 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(3) AtG is filed. According to § 19b(3) AtVfV, the EIA then extends to all measures planned for decommissioning, safe enclosure or dismantling of the facility or parts thereof. For this purpose, the documents specified in § 6(1) and (2) 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 law require a preliminary assessment of the individual case according to § 3e(1) UVPG in conjunction with § 3c UVPG (see Appendix 1 No. 11.1 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(2) 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 whether the prerequisites for approval are fulfilled.

In accordance with §§ 4 to 6 AtVfV, the licensing authority has to announce projects according to § 7 AtG to the public and has to disclose the documents for public inspection. As defined in § 4(4) AtVfV, the licensing authority may waive announcement and public disclosure in the process of issuing licences under § 7(3) AtG (decommissioning, safe enclosure, dismantling) if, according to § 4(2) AtVfV, no additional or other aspects would have to be described in the safety analysis report which give reason to suspect any adverse effects for third parties.

According to § 4(4) 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 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(4) sentence 3 in conjunction with (2) sentence 4 AtVfV).

According to § 8(1) 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(4) AtVfV – since no additional or other aspects would have to be described which give reason to suspect any adverse effects for third – the licensing authority may waive the discussion of objections as defined in § 19b(2) AtVfV (see also § 7(4) AtG).

According to § 2a AtG, the EIA is an integral part of the nuclear licensing procedure that is regulated by the provisions of the AtVfV. § 7(4) AtG 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(1) AtG stipulates, among other things, that the handling of radioactive substances and the possession of facilities of the type referred to in § 7 AtG shall be subject to state supervision. Thus, the decommissioning of nuclear facilities and all other measures associated with safe enclosure or dismantling are subject to supervision under nuclear law, as was the operation of the facility before its decommissioning.

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

5.1 Work permits for decommissioning activities

For the practical work during decommissioning of nuclear facilities, appropriate 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 licence for decommissioning. During the course of decommissioning, such an organisational instrument is of particular importance to ensure radiation protection and occupational safety. All relevant activities in the facility 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 /12/), occupational safety and fire protection, physical protection and all other protection goals related to safety.

For planning, control and monitoring of the work associated with 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 on predefined work items by the authority or authorised experts and subsequent documentation of work performance.

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

5.2 Documentation

The measures carried out during decommissioning are documented in accordance with the terms of the decommissioning licence. This documentation must ensure that the current state 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” /10/, “Requirements for the Documentation of Nuclear Power Plants” /11/ 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 AtG, the documentation obligation according to the decommissioning licence 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 a safety-relevant operating experience if new indications and findings on components that may belong to safety-relevant systems and installations of nuclear facilities in operation are found during dismantling of the facility, if this is still known to the licence holder due to his technical knowledge from own former operation.

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

The requirements concerning the radiological protection documentation according to the StrlSchV remain unaffected.

For release of the facility, including the site, from regulatory control (completion of dismantling of the facility in the scope described in the licence), the competent authority must be provided with a set of documentation under the terms of the licence. This documentation must comprise:

- a description of the state of the site after completion of the decommissioning, and
- 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 regulatory control, analogous to § 70 StrlSchV.

After completion of all decommissioning work, the operator should prepare a final decommissioning report and keep it together with the documentation /15/.

The final decommissioning report summarises the decommissioning, the dismantling of the facility, the whereabouts of the radioactive waste and radioactive residues generated and the final state of the site at the time of release from regulatory control or – if the site is converted to another use under nuclear or radiation protection law – the state of the facility site at the time of conversion to another use.

If after completion of dismantling of the facility in the licensed scope for the site obligations persist (e.g. in terms of existing waste or further monitoring measures), nature and duration of these obligations are to be specified.

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 AtG, are either to be utilised without detrimental effects (e.g. by clearance or reuse in another facility licensed under nuclear or radiation protection law) 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 the relevant provisions of nuclear law, in particular § 2(2) and § 9a AtG, §§ 29, 70, 72 to 79 StrlSchV, guideline on the control of radioactive waste /9/).

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

a) of the AtG and

b) ordinances based on it as well as decisions of administrative authorities

for the use, utilisation, disposal, possession or their transfer to third parties as non-radioactive substances, in short, release from regulatory control (see Section 6.1). The requirements for clearance are regulated in § 29 StrlSchV (see Section 6.3).

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

6.1 Release from regulatory control

The release of a facility as defined in § 7(1) AtG or parts thereof from regulatory control takes place under the terms of the licence according to § 7(5) AtG. For activated or contaminated substances, release takes place by clearance according to § 29 StrlSchV if its contamination is excluded. The general proceeding for this kind of release (removal) is to be described in a licensing document. This is without prejudice to § 44(3) StrlSchV.

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 law (as a new facility or by affiliation with an existing neighbouring facility) without clearance according to § 29 StrlSchV. In this case, the procedure defined under nuclear law is changed into another procedure under nuclear or radiation protection law and thus nuclear supervision is continued.

6.2 Measurement methods and sampling

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

If 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 the contamination and show reproducible removal factors.

The following methods are 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 /19/.

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 defined 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 specific measurement technique are to be clarified in a preliminary analysis. For this analysis, 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. Based on the determined radionuclide mix, the “reference nuclides” (well measurable radionuclides) are to be defined which, 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 provisions laid down in the clearance notice. 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 such that the specific activity or contamination of the material is not underestimated (conservatism of the measurement).

6.3 Clearance

According to § 29 StrlSchV, 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 thereof which are activated or contaminated and which originate from practices pursuant to § 2(1)(a), (c) or (d) StrlSchV 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 regulatory control. 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 licence holder, as regulated in § 29(1) sentence 1 StrlSchV, who will be notified about the clearance decision. This also applies if the purpose of clearance of the radioactive substances the licence holder 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 StrlSchV. A clearance does not replace a licence according to § 7(3) AtG.

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

The 10 microsievert concept can be considered to be met if the clearance values specified for different clearance options in Appendix III Table 1 StrlSchV and the provisions on clearance specified in Appendix IV StrlSchV are complied with. Appendix IV Part A No. 2 StrlSchV stipulates that in the individual case proof can be furnished for deviations from the values of Appendix III StrlSchV or the provisions on clearance specified in Appendix IV StrlSchV – 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(2) sentence 4 StrlSchV, the requirements for clearance may not be brought about, caused or facilitated in a targeted manner by mixing or diluting.

Appendix III Table 1 StrlSchV includes a list of the following clearance options:

1. Unrestricted clearance of
   a) solid substances and liquids,
   b) demolition waste, excavated soil of more than 1,000 t/a,
   c) soil areas,
   d) buildings for reuse and further use;

2. Clearance of
   a) solid substances up to 100 t/a to be disposed of on landfills,
   b) solid substances and liquids up to 100 t/a to be disposed of in an incineration facility,
   c) solid substances up to 1,000 t/a to be disposed of in an incineration facility,
   d) solid substances and liquids up to 1,000 t/a to be disposed of in an incineration facility,
   e) buildings for demolition,
   f) metal debris for recycling.

After clearance under nuclear law, solid or liquid substances cleared to be disposed of on a landfill or in an incinerator facility (2a) as well as metal debris to be recycled (2c) are subject to the provisions of the Circular Economy Act (KrWG). Another use or utilisation must be excluded. In this respect, the regulations of § 29(5) StrlSchV are to be observed. In the case specified under (2a) to (2d), 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 site of the waste management facility 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 the clearance of soil areas in individual cases according to § 29(2) sentence 3 StrlSchV, only those exposure pathways may be disregarded according to Annex IV, Part A, no. 2, sentence 3 StrlSchV which can be ruled out due to the given characteristics of the site, especially due to the geographic location and the geogenic conditions.

For clearance of buildings for reuse and further use (1d), the clearance values according to § 29(2) sentence 2 No. 1(d) and the specifications in Appendix IV Part A No. 1 and Part B and D StrlSchV are to be complied with.

For clearance of buildings for demolition (2e), the building is subjected to clearance measurements in accordance with the provisions of the clearance notice under consideration of the clearance values according to § 29(2) sentence 2 No. 2c StrlSchV and then conventionally demolished. According to Appendix IV Part D StrlSchV, the clearance measurement of a building shall principally take place at the standing structure. In this case, the demolition waste 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 of the building in order to prove compliance with the clearance values for demolition waste (1a and 1b as well as 2a and 2c).
According to Appendix IV Part G StrlSchV, clearance of metal debris for recycling (2f) requires that the cleared metal debris will be melted down.

For decommissioning, the competent authority may determine the procedure to meet the clearance requirements pursuant to § 29(2) StrlSchV in a licence according to § 7(3) AtG or in a separate notice (§ 29(4) StrlSchV). 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 clearance measurement procedures.

The clearance procedure generally comprises:

- the application of the licence holder pursuant to § 29(1) sentence 1 StrlSchV for clearance to be submitted 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 licence holder according to § 29(3) StrlSchV 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 officer of the facility pursuant to § 29(3) StrlSchV 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 and stored (§ 70 StrlSchV),

- the regulatory control, e.g. through further inspection steps based on random samples, where appropriate, involving an authorised expert within the framework of supervision, and

- the further use, utilisation, disposal, possession or transfer to third parties as non-radioactive substance.

Within the framework of supervision, the competent authority has to control compliance with the clearance criteria specified in the clearance notice, the sampling and measurement methods and the conditions of the licence 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 it has been verified by the radiation protection supervisor or radiation protection officer that the respective batch cleared by measurements actually complies with the requirements of the clearance notice as defined in § 29(3) StrlSchV.

Regulatory control may comprise:

- the review of the documentation,

- checking the suitability of the measurement methods, measuring devices, the use of the measuring devices and the technical qualification of the staff,

- control of compliance with the licensed procedure, and,

- where appropriate, own random sample measurements or carried out by a consulted authorised expert.

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 parts thereof (in this section shortly referred to as “materials”) from regulatory control, unless the materials stem from the controlled area. Removal can be applied for materials in areas for which contamination or activation can be excluded on the basis of the operating history and use. Accordingly, a soil area may also be released (removed) from regulatory control without clearance according to § 29 StrlSchV. 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 substances 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, regulatory control terminates without requiring a clearance notice according to § 29 StrlSchV.

This is without prejudice to § 44(3) StrlSchV, i.e. a distinction is to be made between removal and the case of bringing outside. The latter is the case regulated in § 44(3) StrlSchV where movable objects are to be brought outside the controlled area (or upon decision of the authority the supervised area according to § 44(3) sentence 3 StrlSchV) with the objective of reuse or repair and it shall be checked whether these potentially contaminated objects fulfill the prerequisites specified in § 44(3) StrlSchV. In contrast to this, the removal concerns materials which are not subject to limiting objectives in terms of their use and for which it can be confirmed that they are not contaminated or activated by evidence preservation measurements.

6.5 Treatment and storage of radioactive substances

The methods for treatment of radioactive substances and waste arising from the decommissioning of nuclear facilities are generally comparable with the methods for the treatment of radioactive substances and waste 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 for nuclear reactors and nuclear fuel cycle facilities, most of the materials which arise in the course of complete 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 (see StrlSchV, guideline on the control of radioactive waste §9, KTA 3604). In order to reduce the volume of waste, the residues should be separated according to utilisable substances and radioactive wastes already when they arise.

A reduction in the volume of the radioactive waste may be reached and 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 prerequisites of § 6 AtG or § 7 StrlSchV are given, legally admissible. In these cases, further treatment of the large components can take place within the framework of the handling licence.

However, as long as the owner of the facility has not yet decided on how to treat the components and there are objectively still possibilities of utilisation, these substances are not to be considered as radioactive waste (subjective waste term of § 9a(1) AtG). Thus, with regard to the
clearance objective, they can be stored as radioactive residues.

In order to avoid unnecessary radiation exposure of the staff, the treatment of radioactive residues only has to take place to a degree that a longer-term storage is possible and the radioactive waste 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 waste that may arise from utilisation can be transferred to a repository. In this respect, the national waste management programme is to be taken into account.

The storage of unconditioned waste (raw waste) in the facility is to be described and, where necessary, regulated in the licensing notice, as must the preparation for transport or storage of conditioned waste packages at the site of the facility. For the storage of radioactive waste 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 independently. According to § 78 StrlSchV, the radioactive waste from previous operation and decommissioning of the facility is to be kept at a storage facility until it 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 set out above.

For licensing of the storage facility at the site of the facility to be decommissioned, § 7(1) StrlSchV or § 7(3) AtG with extension to § 7(1) StrlSchV may be considered as a legal basis.

Irrespective of the guideline on the control of radioactive waste /9/, it may also be specified in the licensing notice under which prerequisites external conditioning facilities can be made use of. For external transports that might be necessary in this connection and might require a separate licence, the relevant regulations are §§ 16 to 18 StrlSchV.

7 References

/11/ Anforderungen an die Dokumentation bei Kernkraftwerken vom 5. August 1982 (GMBI 1982 S. 546)

IAEA: General Safety Requirement on Decommissioning of Facilities, Part 6, No. GSR Part 6, Vienna, 2014


Merkpostenliste für die Durchführung einer Bewertung des aktuellen Sicherheitsstatus der Anlage für die Nachbetriebsphase mit Anschreiben des BMBF vom 2. Oktober 2014

Sicherheitsanforderungen an Kernbrennstoffversorgungsanlagen von April 1997 und Juni 2004 BMU RS III 3

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

"Dismantling of the facility"

"The dismantling of a nuclear facility includes removal of structures (buildings, systems, components) which were the subject of the licence for construction and operation of the facility in accordance with § 7(1) AtG 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."

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

The dismantling of parts of a facility is an option if these neither come into consideration for safe enclosure nor will be required for the future use of the remaining facility.

"Waste, radioactive"

"According to § 3(2) StrlSchV, radioactive waste is defined as radioactive substances pursuant to § 2(1) AtG, which, according to § 9a AtG, are to be disposed of in a regulated manner, except discharges pursuant to § 47 StrlSchV."

"Shutdown"

"A shutdown of a facility is any cessation or interruption of power operation."

Shutdown as such is covered by the operating licence.

"Facility"

"The facility includes all parts which are covered in a licensing procedure as defined in § 7(1) AtG."

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 regulatory control.

"Operation"

"Operation covers all conditions and processes in the facility between implementation of the first partial operating licence 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 licence continues to be valid.

"Release"

"The release of a facility according to § 7(1) AtG or of parts thereof from being subject to the Atomic Energy Act (also: release from regulatory control) is carried out in accordance with the licence according to § 7(3) AtG. In the case of activated or contaminated substances, release takes place by clearance according to § 29 StrlSchV in a separate administrative act."
“Clearance”

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

a) of the AtG 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 (see § 29(2) sentence 2 No. 1 StrlSchV and Appendix III Table 1 StrlSchV) 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 (see § 29(2) sentence 2 No. 2 StrlSchV and Appendix III Table 1 StrlSchV) aimed at a specific type of utilisation or use.

“Removal”

“In this guide, removal refers to the release of non-contaminated and non-activated substances as well as movable goods, buildings, facilities or parts thereof without clearance according to § 29 StrlSchV from regulatory control on the basis of a procedure described in the licence pursuant to § 7(3) AtG. Accordingly, a soil area may also be released (removed) from regulatory control if its contamination is excluded.”

“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 is to be applied by analogy. For nuclear fuel cycle facilities, the term production operation is usually used and is equivalent to power operation.

“Management system”

“A management system comprises all definitions, regulations and organisational aids that are provided within the company to plan the safety-relevant tasks, to carry them out under controlled conditions and to control and improve their achievement. In this guide, management system refers to a process-oriented, integrated management system.”

“Post-operational phase”

“The post-operational phase of a nuclear facility comprises the period between final cessation of power operation or production in the facility and the utilisation of an enforceable licence for decommissioning, for safe enclosure or for dismantling as defined in § 7(3) AtG by the owner of the nuclear facility.”

“Residual operation”

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

“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 waste management path has not been decided yet, until decision of the licence holder that they are to be classified as radioactive waste. In this sense, the residue

- be utilised in the own or another facility which may lead to the production of radioactive waste, or

- be cleared immediately or after decay storage according to § 29 StrlSchV.”

“Rückbau”

German synonym for “Abbau” (see “Dismantling”)

“Safe enclosure”

“Safe enclosure covers the state and the processes in a shut-down nuclear facility after removal of the nuclear fuel during which it remains unchanged with its main components in their respective condition for a longer period of time and during which the radioactive inventory remains safely contained.”

Regardless of the fact that the radioactive inventory must always be safely contained, this term refers to a certain technical condition of the facility which is also mentioned in § 7(3) AtG as an independent situation for which a licence must be applied for.

“Decommissioning”

“In this guide, the word “decommissioning” is generally used both as single word and as compound term (e.g. decommissioning procedure) in the wider sense as generic term for all activities aimed at decommissioning (including safe enclosure and dismantling). This is in line with technical language and international usage. In contrast, the term “decommissioning” in the AtG (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 reference is made to the legal framework, in particular the AtG, or if decommissioning, safe enclosure and dismantling are mentioned together.”

“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 planning”

“The planning of decommissioning contains specifications on all measures planned for 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 interfere with or prevent other 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 impacts the measures will have, according to the respective stage of planning, on objects of legal protection as defined in § 1a AtVfV.”

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

“Substances, radioactive”

“Radioactive substances in terms of § 2(1) AtG 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 the AtG or a statutory ordinance adopted on the basis of the AtG.”

The term also covers radioactively contaminated components and building structures.

“Preliminary analysis”

“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.”

9 Annex 2: Classification of the BMI/BMUB and KTA standards in terms of their applicability to decommissioning procedures

In Annex 2, the rules are assigned to the different categories. It is based on the listing in the Handbook on Nuclear Safety and Radiation Protection /6/.

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

The announcements issued by the BMI/BMUB and the KTA safety standards were assessed in terms of their applicability to the decommissioning of nuclear facilities and classified according to 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 for decommissioning procedures. However, in case of construction measures that may have to be performed within the framework of decommissioning or significant changes of use, it can be applied adapted to protection goals in terms of Category 3.

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

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

Annex 3 contains comments on the rules adapted to the protection goals or the partial application of rules assigned to Category 3.

| Hand- | Edition 05/16 | Category |
|——— | ———— | ———— |

3.0.1 Safety requirements for nuclear power plants as amended and promulgated on 3 March 2015 (Federal Gazette (BAzn) AT 30.03.2015 B2) 3

3.0.2 Interpretations of the safety requirements for nuclear power plants of 22 November 2012 of 29 November 2013 (Federal Gazette (BAzn) AT 10.12.2013 B4) as amended and promulgated on 3 March 2015 (Federal Gazette (BAzn) AT 30.03.2015 B3) 3
<table>
<thead>
<tr>
<th>Hand-</th>
<th>Edition 05/16</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>n Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Safety criteria for nuclear power plants of 21 October 1977 (Federal Gazette (BAnz) No. 206 of 3 November 1977) and replaced by safety requirements for nuclear power plants of 3 March 2015 updated and replaced by the safety requirements for nuclear power plants of 3 March 2015 and the interpretations thereto of 29 November 2013 as amended and promulgated on 3 March 2015 (see 3.0.1 and 3.0.2)</td>
<td>2</td>
</tr>
<tr>
<td>3.2</td>
<td>Guideline concerning the proof of the technical qualification of nuclear power plant personnel of 24 May 2012 (Joint Ministerial Gazette (GMBl) 2012, page 611) Adaptation of proof of technical qualification of nuclear power plant personnel at nuclear power plants without authorisation for power operation, BMU circular of 21 May 2013 (file number RS 1 6 - 13831-1/1 and 13831-1/2) with Annex 1</td>
<td>3</td>
</tr>
<tr>
<td>3.3</td>
<td>Guideline relating to the proof of the technical qualification of research reactor personnel of 16 February 1994 (Joint Ministerial Gazette (GMBl) 1994, page 366)</td>
<td>3</td>
</tr>
<tr>
<td>3.4</td>
<td>Guidelines concerning the requirements for safety specifications for nuclear power plants of 27 April 1976 (Joint Ministerial Gazette (GMBl) 1976, No. 15, page 199</td>
<td>3</td>
</tr>
<tr>
<td>3.5</td>
<td>List of contents and structure of a standard safety analysis report for nuclear power plants with pressurized water reactor or boiling water reactor of 25 July 1976 (Joint Ministerial Gazette (GMBl) 1976, page 418)</td>
<td>3</td>
</tr>
<tr>
<td>3.6</td>
<td>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 (BAnz) No. 179 of 22 September 1976)</td>
<td>2</td>
</tr>
<tr>
<td>3.7.1</td>
<td>Compilation of information required for review purposes under licensing and supervisory procedures for nuclear power plants of 20 October 1982 (Federal Gazette (BAnz) No. 6a of 11 January 1983)</td>
<td>3</td>
</tr>
<tr>
<td>3.7.2</td>
<td>Compilation of the data required for the building inspection of nuclear facilities of 6 November 1981 (Joint Ministerial Gazette (GMBl) 1981, page 518)</td>
<td>3</td>
</tr>
<tr>
<td>Hand-</td>
<td>Edition 05/16</td>
<td>Category</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>Safety and Radiation Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.18 Licences under § 3(1) StrlSchV or § 6 AtG concerning the intermediate storage of depleted and/or natural and enriched uranium in the form of uranium hexafluoride (UF6); topic: licensing assumptions and requirements of 15 February 1979 (Joint Ministerial Gazette (GMBI) 1979, page 91)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3.19 Guideline according to StrlSchV and R6V on occupational medical care for occupationally exposed persons by approved medical practitioners of 18 December 2003 (Joint Ministerial Gazette (GMBI) 2004 page 350)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>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 (GMBI) 1983, page 176)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3.21 Interpretation of § 4(4) sentence 1(2e) StrlSchV of 20 September 1979 (Joint Ministerial Gazette (GMBI) 1979, page 631) (May still be relevant for older decommissioning licences.)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3.22 Checklist for carrying out an assessment of the current safety status of the facility for the post-operational phase with BMUB cover letter of 2 October 2014</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3.23 Guideline concerning emission and immobilisation monitoring of nuclear installations (REI) of 7 December 2005 (Joint Ministerial Gazette (GMBI) 2006, page 254)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3.24 Guideline on leak tests on sealed radioactive substances of 4 February 2004 (Joint Ministerial Gazette (GMBI) 2004, page 530), amended on 7 September 2012 (Joint Ministerial Gazette (GMBI) 2012, page 919)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3.25 Principles relating to the provision to be made for the handling and disposal of spent fuel of nuclear power plants 19 March 1980 (Federal Gazette (BAnz) No. 58 of 22 March 1980)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>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, page 153)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>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)</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hand-</th>
<th>Edition 05/16</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety and Radiation Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.33.1 Guidelines for the assessment of the design of nuclear power plants with pressurised water reactors against accidents as defined in § 28(3) StrlSchV (incident guidelines) of 18 October 1983 (Federal Gazette (BAnz) No. 59/83 of 31 December 1983), updated and replaced by the safety requirements for nuclear power plants of 3 March 2015 and the interpretations thereto of 29 November 2013 as amended and promulgated on 3 March 2015 (see 3.0.1 and 3.0.2)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3.33.2 Incident calculation bases for the guidelines for the assessment of the design of nuclear power plants with PWR according to § 28(3) StrlSchV of 18 October 1983 (Federal Gazette (BAnz) No. 59/83 of 31 December 1983) version of Chapter 4 on the calculation of radiation exposure of 29 June 1994 (Federal Gazette (BAnz) No. 222a of 26 November 1994), amendment of Chapter 4 on the calculation of radiation exposure according to § 49 StrlSchV of 20 July 2001 adopted at the 186th meeting of the Commission on Radiological Protection on 11 September 2003, published in Issue 44, 2004 in the series of reports of the Commission on Radiological Protection</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3.34 Framework guideline on the preparation of expert opinions in nuclear administrative procedures of 15 December 1983 (Joint Ministerial Gazette (GMBI) 1984, page 21)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3.36 Calculation basis for the determination of radiation exposure due to disruptive action or other interference by third parties (SEW) on nuclear facilities and installations – SEW-Berechnungsgrundlage of 28 October 2014 (Joint Ministerial Gazette (GMBI) 2014, page 1315)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>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 Ministerial Gazette (GMBI) 1984, No. 21, page 327</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Page 21 of 37</td>
<td></td>
<td></td>
</tr>
</tbody>
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</thead>
<tbody>
<tr>
<td>3.38</td>
<td>3</td>
<td>Guideline for the maintenance of technical qualification of responsible nuclear power plant personnel of 17 July 2013 (Joint Ministerial Gazette (GMBl) 2013, page 712) Adaptation of the maintenance of technical qualification of nuclear power plant personnel at nuclear power plants without authorisation for power operation, BMUB circular of 23 January 2014 (file number RS 1 6 - 13831-1/3) with annex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.39</td>
<td>3</td>
<td>Guideline relating to the contents of the examination of the technical qualification of 24 May 2012 (Joint Ministerial Gazette (GMBl) 2012, page 905) Adaptation of the contents of the examination of the technical qualification of nuclear power plant personnel at nuclear power plants without authorisation for power operation, BMU circular of 21 May 2013 (file number RS 1 6 - 13831-1/1 and 13831-1/2) with Annex 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.40</td>
<td>1</td>
<td>Guideline relating to the technical qualification required in radiological protection according to StrlSchV of 21 June 2004 (Joint Ministerial Gazette (GMBl) 2004, page 799), as amended on 19 April 2006 (Joint Ministerial Gazette (GMBl) 2006, page 735)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.41</td>
<td>1</td>
<td>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, page 342)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.42.1</td>
<td>1</td>
<td>Guideline for physical radiological protection controls for determining body doses Part 1: Determination of body dose due to external radiation exposure (incorporation monitoring) (§§ 40, 41, 42 StrlSchV: § 35 RöV) of 8 December 2003 (Joint Ministerial Gazette (GMBl) 2004, page 410)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.42.2</td>
<td>1</td>
<td>Guideline for physical radiological protection controls for determining body doses Part 2: Determination of body dose due to external radiation exposure (incorporation monitoring) (§§ 40, 41, 42 StrlSchV) of 12 January 2007 (Joint Ministerial Gazette (GMBl) 2007, page 623), Appendices 1 to 6, Appendix 7.1, Appendix 7.2, Appendix 7.3, Appendix 7.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.43.1</td>
<td>3</td>
<td>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, page 418)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.43.2</td>
<td>1</td>
<td>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, page 258)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.44</td>
<td>1</td>
<td>Guideline on the verification of the licensee's monitoring of radioactive effluents from nuclear power plants of 5 February 1996 (Joint Ministerial Gazette (GMBl) 1996, page 247)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.45</td>
<td>2</td>
<td>Licences under the terms of § 3(1) StrlSchV 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, page 120)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.46.1</td>
<td>2</td>
<td>Licence under § 8(1) StrlSchV for the carriage of radioactive substances for radiographic examinations within the frame of the nondestructive testing of materials of 29 May 1978 (Joint Ministerial Gazette (GMBl) 1978, page 334)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.46.2</td>
<td>2</td>
<td>Instruction sheet for the carriage of radioactive materials for radiographic examinations within the frame of the nondestructive testing of materials of 20, November 1981 (Joint Ministerial Gazette (GMBl) 1982, page 22)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.47</td>
<td>1</td>
<td>Licences under § 20 StrlSchV (sample licence for activities subject to licensing in third-party installations or facilities) of 21 September 1990 and 2 November 1990 (Joint Ministerial Gazette (GMBl) 1990, page 848)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.48</td>
<td>1</td>
<td>Guideline for the Design Approval of Ionization Chamber Smoke Detectors of 15 February 1992 (Joint Ministerial Gazette (GMBl) 1992, page 150)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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, page 208), updated and replaced by the safety requirements for nuclear power plants of 3 March 2015 and the interpretations thereto of 29 November 2013 as amended and promulgated on 3 March 2015 (see 3.0.1 and 3.0.2)

3.50 Interpretations of the safety criteria for nuclear power plants of 17 May 1979 (Joint Ministerial Gazette (GMBI) 1979, page 161) on safety criterion 2.6: external hazards, on safety criterion 8.5: heat removal from the containment, updated and replaced by the safety requirements for nuclear power plants of 3 March 2015 and the interpretations thereto of 29 November 2013 as amended and promulgated on 3 March 2015 (see 3.0.1 and 3.0.2)

3.51 Interpretations of the safety criteria for nuclear power plants of 28 November 1979 (Joint Ministerial Gazette (GMBI) 1980, page 90) on safety criterion 2.2: testability, on safety criterion 2.3: radiation exposure in the environment, on safety criterion 2.6: external hazards, on safety criterion 2.7: protection against fire and explosion supplementary interpretation on safety criterion 4.3: residual heat removal after loss-of-coolant accidents, updated and replaced by the safety requirements for nuclear power plants of 3 March 2015 and the interpretations thereto of 29 November 2013 as amended and promulgated on 3 March 2015 (see 3.0.1 and 3.0.2)

3.52.1 - Explanatory notes on the reporting criteria for reportable events according to Appendix 1 AtSMV (as of 09/2015)

- Explanatory notes on the reporting criteria for reportable events according to Appendix 2 AtSMV (as of 11/2007)

- Explanatory notes on the reporting criteria for reportable events according to Appendix 3 AtSMV (as of 03/2007)

- Explanatory notes on the reporting criteria for reportable events according to Appendix 4 AtSMV (as of 04/2007)

- Explanatory notes on the reporting criteria for reportable events according to Appendix 5 AtSMV (as of 04/2013)

- Compilation of terms used in the reporting criteria of the AtSMV (as of 04/2015)

3.52.2 Reporting of a reportable event in installations according to § 7 AtG for the fission of nuclear fuels (reporting form, as of 04/08)

3.52.3 Reporting of a reportable event in installations according to § 7 AtG of the nuclear fuel cycle (reporting form, as of 04/08)

3.52.4 Reporting of a reportable event during the storage of solidified high-level fission product solutions according to § 6 AtG (reporting form, as of 04/08)

3.53 Guideline relating to the contents of the examination of the technical qualification of responsible shift personnel in research reactors of 14 November 1997 (Joint Ministerial Gazette (GMBI) 1997, page 794)

3.54.1 Basic recommendation for remote monitoring of nuclear power plants of 12 August 2005 (Joint Ministerial Gazette (GMBI) 2005, page 1048)

3.54.2 Recommendation for calculating the fee as defined in § 5 AtKostV for the remote monitoring of nuclear power plants of 21 January 1983 (Joint Ministerial Gazette (GMBI) 1983, page 146)

## Hand- 
book on 
Nuclear 
Safety 
and 
Radiation 
Protection 
Edition 05/16 
Category 

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.56</td>
<td>Notice on the application of the German version of the International Nuclear and Radiological Event Scale (INES) in nuclear facilities and in the field of radiation protection outside the scope of nuclear technology – German INES Handbook of 20 February 2015 Federal Gazette (BAnz) AT 30.03.2015 B1</td>
<td>1</td>
</tr>
<tr>
<td>3.57.1</td>
<td>Requirements relating to the physical protection service and physical protection officers in nuclear installations and facilities (OSD-Richtlinie) of 4 July 2008 (Joint Ministerial Gazette (GMBI) 2008, page 810)</td>
<td>3</td>
</tr>
<tr>
<td>3.57.3</td>
<td>Guideline for protecting LWR nuclear power plants against disruptive action or other interference by third parties of 6 December 1995 (Joint Ministerial Gazette (GMBI) 1996, page 32)</td>
<td>3</td>
</tr>
<tr>
<td>3.59</td>
<td>Guideline on the control of radioactive waste with negligible heat generation that is not handed over to a Land collection facility of 16 January 1989 (Federal Gazette (BAnz) No. 63a of 4 April 1989), last amended on 14 January 1994 (Federal Gazette (BAnz) page 725)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Note: The regulation was replaced by the guideline for the control of radioactive residues and radioactive wastes of 19 November 2008 in terms of contents (see 3.60), but not officially withdrawn.</td>
<td></td>
</tr>
<tr>
<td>3.60</td>
<td>Guideline on the control of radioactive residues and radioactive waste of 19 November 2008 (Federal Gazette (BAnz) page 4777)</td>
<td>1</td>
</tr>
<tr>
<td>3.61</td>
<td>Guideline for the technical qualification of radiation protection officers at installations for fission of nuclear fuels of 20 February 2014 (Joint Ministerial Gazette (GMBI) 2014, page 289)</td>
<td>3</td>
</tr>
<tr>
<td>3.62</td>
<td>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, page 228)</td>
<td>3</td>
</tr>
<tr>
<td>3.63.1</td>
<td>Guideline for the protection of radioactive substances against disruptive action or other interference by third parties during transportation of 4 December 2003 (Joint Ministerial Gazette (GMBI) 2004, page 238)</td>
<td>2</td>
</tr>
<tr>
<td>3.64</td>
<td>Requirements on security personnel in the transport of radioactive materials of 4 June 1996 (Joint Ministerial Gazette (GMBI) 1996, page 621 and page 673)</td>
<td>2</td>
</tr>
<tr>
<td>3.65</td>
<td>Requirements on courses for imparting basic nuclear knowledge for responsible shift personnel in nuclear power plants – criteria for recognition – of 19 November 2014</td>
<td>2</td>
</tr>
<tr>
<td>3.68</td>
<td>Safeguards for protecting nuclear facilities with Category III nuclear material of 20 April 1993 (Joint Ministerial Gazette (GMBI) 1993, page 365) (without text)</td>
<td>3</td>
</tr>
<tr>
<td>3.71</td>
<td>Guideline relating to the technical qualification of responsible personnel in facilities for the production of fuel elements for nuclear power plants of 30 November 1995 (Joint Ministerial Gazette (GMBI) 1996, page 29)</td>
<td>3</td>
</tr>
<tr>
<td>3.73</td>
<td>Guide to the decommissioning, the safe enclosure and the dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act of 23 June 2016 (Federal Gazette (BAnz) AT 19.07.2016 B7)</td>
<td>1</td>
</tr>
<tr>
<td>3.74.1</td>
<td>Guideline for conducting periodic safety reviews (PSRs) for nuclear power plants in the Federal Republic of Germany</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>- Fundamentals for periodic safety reviews for nuclear power plants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Guideline safety status analysis</td>
<td></td>
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<td>- Guideline probabilistic safety analysis</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Edition 05/16</th>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.74.2 Guideline for conducting periodic safety reviews (PSRs) for nuclear power plants in the Federal Republic of Germany, under revision - Guideline deterministic security analysis Announcement of 25 June 1998 (Federal Gazette (BAnz) page 12 257)</td>
<td>2</td>
<td>1200 General, administration; organisation</td>
</tr>
<tr>
<td>3.75 Checklist for protecting other radioactive material and small amounts of nuclear fuel against diversions from installations and facilities of 3 April 2003, BMU circular of 10 July 2003 – RS I 6 13151-6/18</td>
<td>1</td>
<td>1202 Requirements for the Testing Manual h, 11/09</td>
</tr>
<tr>
<td>3.76 Guideline on the physical protection of storage facilities against disruptive action or other interference by third parties (SEWD-Richtlinie Zwischenlager) of 4 February 2013 (Joint Ministerial Gazette (GMBI) 2013, page 379)</td>
<td>3</td>
<td>1203 Requirements for the Emergency Manual, 11/09</td>
</tr>
<tr>
<td>3.79 Damage prevention not relating to design basis accidents, BMU circular of 15 July 2003 RS I 3 – 10100/00</td>
<td>3</td>
<td>1300 Industrial safety</td>
</tr>
<tr>
<td>3.80 Resolution of the Länder 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 RS I 1 – 17031/47</td>
<td>1</td>
<td>1301.1 Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 1: Design, 11/12</td>
</tr>
<tr>
<td>3.99 Announcement regarding the guideline for the protection of IT systems in nuclear installations and facilities of physical protection categories I and II against disruptive action or other interferences by third parties (SEWD-Richtlinie IT), regarding the load assumptions for the design of nuclear installations and facilities against disruptive action or other interference by third parties by means of IT attacks (IT load assumptions) and the explanations for the assignment of the IT systems of nuclear power plants to IT protection requirements classes (explanatory notes) &quot;of 8 July 2013 (Joint Ministerial Gazette (GMBI) 2013, page 711) (without text)</td>
<td>3</td>
<td>1301.2 Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 2: Operation, 11/14</td>
</tr>
<tr>
<td>Edition 05/16 applicable KTA safety standards (as at 3 May 2016)</td>
<td>Category</td>
<td></td>
</tr>
<tr>
<td>1204 Documentation during the Construction and Operation of Nuclear Power Plants, 11/13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1400 Quality assurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1401 General Requirements Regarding Quality Assurance, 11/13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1402 Integrated Management Systems for the Safe Operation of Nuclear Power Plants, 11/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1403 Ageing Management in Nuclear Power Plants, 11/10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1404 Documentation during the Construction and Operation of Nuclear Power Plants, 11/13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1408.1 Quality Assurance for Weld Filler Materials and Welding Consumables for Pressure and Activity Retaining Systems in Nuclear Power Plants; Part 1: Qualification Testing, 11/15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1408.2 Quality Assurance for Weld Filler Materials and Welding Consumables for Pressure and Activity Retaining Systems in Nuclear Power Plants; Part 2: Manufacture, 11/15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1408.3 Quality Assurance for Weld Filler Materials and Welding Consumables for Pressure and Activity Retaining Systems in Nuclear Power Plants; Part 3: Processing, 11/15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1500 Radiation protection and monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1501 Stationary System for Monitoring the Local Dose Rate within Nuclear Power Plants, 11/10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1502 Monitoring Volumetric Activity of Radioactive Substances in the Inner Atmosphere of Nuclear Power Plants, 11/13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1502.2 Monitoring Radioactivity in the Inner Atmosphere of Nuclear Power Plants; Part 2: Nuclear Power Plants with High Temperature Reactors, 6/89 (in-active safety standard)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand-</td>
<td>Edition 05/16 applicable KTA safety standards (as at 3 May 2016)</td>
<td>Category</td>
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<td>tion</td>
<td></td>
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<tr>
<td>(3102.4)</td>
<td>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 (in-active safety standard)</td>
<td></td>
</tr>
<tr>
<td>(3102.5)</td>
<td>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 (in-active safety standard)</td>
<td></td>
</tr>
<tr>
<td>3103</td>
<td>Shutdown Systems for Light Water Reactors, 11/15</td>
<td></td>
</tr>
<tr>
<td>(3104)</td>
<td>Determination of the Shutdown Reactivity, 10/79 (in-active safety standard)</td>
<td></td>
</tr>
<tr>
<td>3107</td>
<td>Nuclear Criticality Safety Requirements during Refuelling, 11/14</td>
<td></td>
</tr>
<tr>
<td>3200</td>
<td>Primary and secondary circuits all 2</td>
<td></td>
</tr>
<tr>
<td>3201.1</td>
<td>Components of the Reactor Coolant Pressure Boundary of Light Water Reactors; Part 1: Materials and Product Forms, 6/98</td>
<td></td>
</tr>
<tr>
<td>3201.2</td>
<td>Components of the Reactor Coolant Pressure Boundary of Light Water Reactors; Part 2: Design and Analysis, 11/13</td>
<td></td>
</tr>
<tr>
<td>3201.3</td>
<td>Components of the Reactor Coolant Pressure Boundary of Light Water Reactors; Part 3: Manufacture, 11/07</td>
<td></td>
</tr>
<tr>
<td>3201.4</td>
<td>Components of the Reactor Coolant Pressure Boundary of Light Water Reactors; Part 4: In-service Inspections and Operational Monitoring, 11/10</td>
<td></td>
</tr>
<tr>
<td>3203</td>
<td>Surveillance of the Irradiation Behaviour of Reactor Pressure Vessel Materials of LWR Facilities, 6/01</td>
<td></td>
</tr>
<tr>
<td>3204</td>
<td>Reactor Pressure Vessel Internals, 11/15</td>
<td></td>
</tr>
<tr>
<td>3205.1</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td>3205.2</td>
<td>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, 11/15</td>
<td></td>
</tr>
<tr>
<td>3205.3</td>
<td>Component Support Structures with Non-Integral Connections for Pressure and Activity-Retaining Components in Systems Outside the Primary Circuit; Part 3: Series-Production Standard Supports, 11/06</td>
<td></td>
</tr>
<tr>
<td>3206</td>
<td>Verification Analysis for Rupture Preclusion for Pressure Retaining Components in Nuclear Power Plants, 11/14</td>
<td></td>
</tr>
<tr>
<td>3211.1</td>
<td>Pressure and Activity Retaining Components of Systems Outside the Primary Circuit; Part 1: Materials, 11/15</td>
<td></td>
</tr>
<tr>
<td>3211.2</td>
<td>Pressure and Activity Retaining Components of Systems Outside the Primary Circuit; Part 2: Design and Analysis, 11/13</td>
<td></td>
</tr>
<tr>
<td>3211.3</td>
<td>Pressure and Activity Retaining Components of Systems Outside the Primary Circuit; Part 3: Manufacture, 11/12</td>
<td></td>
</tr>
<tr>
<td>3211.4</td>
<td>Pressure and Activity Retaining Components of Systems Outside the Primary Circuit; Part 4: In-service Inspections and Operational Monitoring, 11/13</td>
<td></td>
</tr>
<tr>
<td>3300</td>
<td>Heat removal all 2</td>
<td></td>
</tr>
<tr>
<td>3301</td>
<td>Residual Heat Removal Systems of Light Water Reactors, 11/15</td>
<td></td>
</tr>
<tr>
<td>3303</td>
<td>Heat Removal Systems for Fuel Assembly Storage Pools in Nuclear Power Plants with Light Water Reactors, 11/15</td>
<td></td>
</tr>
<tr>
<td>3400</td>
<td>Containment all 2</td>
<td></td>
</tr>
<tr>
<td>3401.1</td>
<td>Steel Containment Vessels; Part 1: Materials, 9/88</td>
<td></td>
</tr>
<tr>
<td>3401.2</td>
<td>Steel Containment Vessels; Part 2: Analysis and Design, 6/85</td>
<td></td>
</tr>
<tr>
<td>3401.3</td>
<td>Steel Containment Vessels; Part 3: Manufacture, 11/86</td>
<td></td>
</tr>
<tr>
<td>3401.4</td>
<td>Steel Containment Vessels; Part 4: In-service Inspections and Operational Monitoring, 6/91</td>
<td></td>
</tr>
<tr>
<td>3402</td>
<td>Airlocks on the Reactor Containment of Nuclear Power Plants – Personnel Airlocks, 11/14</td>
<td></td>
</tr>
<tr>
<td>3403</td>
<td>Cable Penetrations through the Reactor Containment Vessel, 11/15</td>
<td></td>
</tr>
<tr>
<td>3404</td>
<td>Isolation of Operating System Pipes Penetrating the Containment Vessel in the Case of a Release of Radioactive Substances into the Containment Vessel of Nuclear Power Plants, 11/13</td>
<td></td>
</tr>
<tr>
<td>3405</td>
<td>Leakage Test of the Containment Vessel, 11/15</td>
<td></td>
</tr>
<tr>
<td>3407</td>
<td>Pipe Penetrations through the Reactor Containment Vessel, 11/14</td>
<td></td>
</tr>
<tr>
<td>Hand-</td>
<td>Edition 05/16 applicable KTA safety standards (as at 3 May 2016)</td>
<td>Category</td>
</tr>
<tr>
<td>Book on Nuclear Safety and Radiation Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3409</td>
<td>Airlocks on the Reactor Containment of Nuclear Power Plants – Equipment airlocks, 11/09</td>
<td></td>
</tr>
<tr>
<td>3413</td>
<td>Determination of Loads for the Design of a Full Pressure Containment Vessel against Plant-internal Incidents, 6/89</td>
<td></td>
</tr>
<tr>
<td>3500</td>
<td>Instrumentation and reactor protection</td>
<td>all 3</td>
</tr>
<tr>
<td>3501</td>
<td>Reactor Protection System and Monitoring Equipment of the Safety System, 11/15</td>
<td></td>
</tr>
<tr>
<td>3502</td>
<td>Accident Measuring Systems, 11/12</td>
<td></td>
</tr>
<tr>
<td>3503</td>
<td>Type Testing of Electrical Modules for the Safety Related Instrumentation and Control System, 11/15</td>
<td></td>
</tr>
<tr>
<td>3504</td>
<td>Electrical Drive Mechanisms of the Safety System in Nuclear Power Plants, 11/15</td>
<td></td>
</tr>
<tr>
<td>3505</td>
<td>Type Testing of Measuring Sensors and Transducers of the Safety-Related Instrumentation and Control System, 11/15</td>
<td></td>
</tr>
<tr>
<td>3506</td>
<td>System Testing of the Instrumentation and Control Equipment Important to Safety of Nuclear Power Plants, 11/12</td>
<td></td>
</tr>
<tr>
<td>3600</td>
<td>Activity control and activity management</td>
<td></td>
</tr>
<tr>
<td>3601</td>
<td>Ventilation Systems in Nuclear Power Plants, 11/05</td>
<td>3</td>
</tr>
<tr>
<td>3602</td>
<td>Storage and Handling of Fuel Assemblies and Associated Items in Nuclear Power Plants with Light Water Reactors, 11/03</td>
<td>1</td>
</tr>
<tr>
<td>3603</td>
<td>Facilities for Treating Radioactively Contaminated Water in Nuclear Power Plants, 11/09</td>
<td>1</td>
</tr>
<tr>
<td>3604</td>
<td>Storage, Handling and Plant-internal Transport of Radioactive Substances in Nuclear Power Plants (with the Exception of Fuel Assemblies), 11/05</td>
<td>1</td>
</tr>
<tr>
<td>3605</td>
<td>Treatment of Radioactively Contaminated Gases in Nuclear Power Plants with Light Water Reactors, 11/12</td>
<td>3</td>
</tr>
<tr>
<td>3700</td>
<td>Energy and media supply</td>
<td>all 3</td>
</tr>
<tr>
<td>3701</td>
<td>General Requirements for the Electrical Power Supply in Nuclear Power Plants, 11/14</td>
<td></td>
</tr>
</tbody>
</table>
10. Annex 3: Comments on application adapted to protection goals or partial application of the BMI/BMUB announcements and KTA safety standards in decommissioning procedures

The announcements issued by the BMI/BMUB and the KTA safety standards were assessed in terms of their applicability to the decommissioning of nuclear facilities and classified according to 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 for decommissioning procedures. However, in case of construction measures that may have to be performed within the framework of decommissioning or significant changes of use, it can be applied adapted to protection goals in terms of Category 3.

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

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

3.0.1 Safety requirements for nuclear power plants as amended and promulgated on 3 March 2015 (Federal Gazette (BAnz) AT 30.03.2015 B2)

The safety requirements for nuclear power plants are to be applied as appropriate to the requirements of decommissioning.

The defence-in-depth concept as presented in the safety requirements for nuclear power plants is not applicable to decommissioning. However, the technical requirements described are to be applied for compliance with the protection goals stated and with the radiological safety objectives, adapted to the events still to be postulated during the decommissioning phase so that these events can be avoided or controlled. Requirement 3.11 (7) refers to decommissioning.

3.0.2 Interpretations of the safety requirements for nuclear power plants of 22 November 2012 of 29 November 2013 (Federal Gazette (BAnz) AT 10.12.2013 B4) as amended and promulgated on 3 March 2015 (Federal Gazette (BAnz) AT 30.03.2015 B3)

The interpretations of the safety requirements refer only in a few cases to requirements that are still relevant in the decommissioning phase and are significantly reduced after removal of the fuel assemblies.

3.4 Guidelines concerning the requirements for safety specifications for nuclear power plants of 27 April 1976 (Joint Ministerial Gazette (GMBl) 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 changed 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 List of contents and structure of a standard safety analysis report for nuclear power plants with pressurized water reactor or boiling water reactor of 26 July 1976 (Joint Ministerial Gazette (GMBl) 1976, page 418)

The aim of this checklist 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 changes and decreases significantly during decommissioning, particularly after removal of the fuel core, this list can only be applied to a very limited extent in the decommissioning procedure.

If the existing list is used, then the following should be noted:

The information and data on the site and the facility should primarily include the changes occurred during the operating period and due to operation and should, in particular, characterise the radiological situation.

Information about the overall decommissioning project are to be presented with the application for a licence 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 into account the situations in which a licence must be applied for according to § 7(3) AIG (decommissioning, safe enclosure, dismantling of the facility or parts thereof). This information should make it possible to assess, in particular, whether further procedures would be interfered with or prevented and whether provisions are made for an appropriate order of dismantling activities in terms of radiation protection.

The description of decommissioning measures should include the intended techniques, the proceeding and the related radiation protection and safety aspects, as well as the intended final state of the facility.

Furthermore, it is important to outline what provisions have been made in terms of spent fuel and radioactive waste management and to provide details on physical protection measures as well as 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 (BAnz) No. 6a of 11 January 1983)

This compilation of information for review purposes is divided into sections of information for individual systems and facilities. These sections are divided up according to different phases of manufacture, construction and commissioning of the facility or individual systems that are mainly oriented towards the chronological sequence of inspections carried out within the licensing and supervisory procedure.

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

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

The information to be submitted should at least correspond to the scope set out in Section 3.2 of the guide.

3.7.2 Compilation of the data required for the building inspection of nuclear facilities of 6 November 1981 (Joint Ministerial Gazette (GMBI) 1981, 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 documents 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 the context of the 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. The requirements deal with the documentation of material and building inspections. They should only be applied to components of the activity containment and documentation category C should, in general, 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 refers to 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 vicinity of nuclear facilities of 27 October 2008 (Joint Ministerial Gazette (GMBI) 2008, page 1278), replaced by the basic recommendations for emergency preparedness in the vicinity of nuclear facilities of the SSK of 19/20 February 2015 (Federal Gazette (BAnz) AT 04.01.2016 B4)

3.15.2 Radiological fundamentals for decisions on measures for the protection of the population against accidental releases of radionuclides of 27 October 2008 (Joint Ministerial Gazette (GMBI) 2008, page 1278) with annex on the use of iodine tablets for blocking of the thyroid in case of a nuclear accident

The basic recommendations and the radiological fundamentals are to be applied. However, the scope of civil protection measures should be agreed with the competent authorities on the basis of the reduced potential risk and hazard of the actual facility.

The same also applies to guidelines issued by the Länder.

3.21 Interpretation of § 4(4) sentence 1(2e) StrfSchV of 20 September 1979 (Joint Ministerial Gazette (GMBI) 1979, page 631) (May still be relevant for older decommissioning licences.)

Clearance is based on the specifications of § 29 StrfSchV.

The basis of the exemption levels for unrestricted clearance of substances is the 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, 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 respective state of the facility.

3.33.1 Guidelines for the assessment of the design of nuclear power plants with pressurised water reactors against accidents as defined in § 28(3) StrfSchV (incident guidelines) of 18 October 1983 (Federal Gazette (BAnz) No. 59/83 of 31 December 1983), updated and replaced by the safety requirements for nuclear power plants of 3 March 2015 and the interpretations thereto of 29 November 2013 as amended and promulgated on 3 March 2015 (see 3.0.1 and 3.0.2)

The incidents and accidents 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. Other provisions 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, page 418)

This regulation is not applicable to the decommissioning procedure.

Thus, it can only be applied for the construction of facilities necessary for decommissioning in the scope of § 7(1) AtG in accordance with the protection goals.

3.54.1 Basic recommendation for remote monitoring of nuclear power plants of 12 August 2005 (Joint Ministerial Gazette (GMBI) 2005, page 1049)

3.54.2 Recommendation for calculating the fee as defined in § 5 AtKostV for the remote monitoring of nuclear power plants of 21 January 1983 (Joint Ministerial Gazette (GMBI) 1983, page 146)

After cessation of operation or after complete removal of the nuclear fuel the potential hazard is significantly 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, page 810)

This guideline is to be applied, adapted 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 action or other interference by third parties of 6 December 1995 (Joint Ministerial Gazette (GMBI) 1996, page 32) (without text)

The protection goals listed in the guideline (theft of nuclear material, loss of primary coolant, residual heat...
removal) are generally no longer relevant for a facility under decommissioning after removal of the nuclear fuel. The protection goal is to prevent unnoticed theft and release of other radioactive substances. The guideline is therefore only to be applied in this sense.

3.59 Guideline on the control of radioactive waste with negligible heat generation that is not handed over to a Land collection facility of 16 January 1989 (Federal Gazette (BAnz) No. 63a of 4 April 1989), last amended on 14 January 1994 (Federal Gazette (BAnz) page 725)

The regulation was replaced by the guideline for the control of radioactive residues and radioactive wastes of 19 November 2008 in terms of contents (see 3.60), but not officially withdrawn.

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 (GMBl) 1991, page 228)

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

3.68 Safeguards for protecting nuclear facilities with Category III nuclear material of 20 April 1993 (Joint Ministerial Gazette (GMBl) 1993, page 365) (without text)

This guideline is to be applied adapted to the quantities of nuclear fuels or other radioactive substances still present in the facility and depending on the decommissioning stage reached.

3.76 Guideline on the physical protection of storage facilities against disruptive action or other interference by third parties (SEWD-Richtlinie Zwischenlager) of 4 February 2013 (Joint Ministerial Gazette (GMBl) 2013, page 379)

If the physical protection concept of a near-site storage facility takes into account the physical protection measures implemented at the nuclear power plant site, the guideline must be applied in order to prevent inadmissible impacts on the physical protection concept of the storage facility.

3.79 Damage prevention not relating to design basis accidents, BMU circular of 15 July 2003 RS I 3 – 10100/00

As long as there is still nuclear fuel in the facility during decommissioning exceeding the masses or concentrations specified in § 2(3) AIG, the necessary requirements to ensure damage prevention must be complied with.

3.99 Announcement regarding the guideline for the protection of IT systems in nuclear Installations and facilities of physical protection categories I and II against disruptive action or other interference by third parties (SEWD-Richtlinie IT), regarding the load assumptions for the design of nuclear installations and facilities against disruptive action or other interference by third parties by means of IT attacks (IT load assumptions) and the explanations for the assignment of the IT systems of nuclear power plants to IT protection requirements classes (explanatory notes) of 8 July 2013 (Joint Ministerial Gazette (GMBl) 2013, page 711)

As long as the nuclear facility is assigned to physical protection category I and II, the requirements of the guideline must be complied with.

Comments on the technical qualification guidelines

3.2 Guideline concerning the proof of the technical qualification of nuclear power plant personnel of 24 May 2012 (Joint Ministerial Gazette (GMBl) 2012, page 611)

Adaptation of proof of technical qualification of nuclear power plant personnel at nuclear power plants without authorisation for power operation, BMU circular of 21 May 2013 (file number RS I 6 - 13831-1/1 and 13831-1/2) with Annex 1

3.38 Guideline for the maintenance of technical qualification of responsible nuclear power plant personnel of 17 July 2013 (Joint Ministerial Gazette (GMBl) 2013, page 712)

Adaptation of the maintenance of technical qualification of nuclear power plant personnel at nuclear power plants without authorisation for power operation, BMU circular of 23 January 2014 (file number RS I 6 - 13831-1/3) with annex

3.39 Guideline relating to the contents of the examination of the technical qualification of 24 May 2012 (Joint Ministerial Gazette (GMBl) 2012, page 905)

Adaptation of the contents of the examination of the technical qualification of nuclear power plant personnel at nuclear power plants without authorisation for power operation, BMU circular of 21 May 2013 (file number RS I 6 - 13831-1/1 and 13831-1/2) with Annex 2

The applicability of the above-mentioned technical qualification guidelines and their respective adaptations for nuclear power plants without authorisation for power operation is determined by the state of the facility and, in particular, by the quantities of nuclear fuels still present in the facility. According to Guideline 3.2, Section 1.2, the competent supervisory and licensing authority decides on the application to decommissioned facilities under decommissioning on a case-by-case basis. For practical application, the following should be considered:

1. As long as there are nuclear fuels or other radioactive substances with comparable potential hazards in the facility, the requirements in terms of technical qualification apply as described in the adaptations for nuclear power plants without authorisation for power operation. Examinations 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,
   - maintenance of subcriticality in the fuel pool and reactor pressure vessel,
   - ensuring residual heat removal under the conditions of the post-operational phase and control of possible malfunctions or incidents,
   - monitoring and retention/enclosure of radioactive substances, particularly in connection with the decontamination of activity-carrying systems.

Issues relating to electrical engineering, instrumentation and control and external systems should concentrate on the functions of the systems.
4. Subjects which must be included to a greater extent in staff training, proof of technical qualification and maintenance of technical qualification are:

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

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

6. After removal of the nuclear fuel, a greater distinction can be made during the decommissioning procedure between the requirements for existing staff and new staff regarding the proof of technical qualification. Existing staff who have demonstrated and maintained 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 staff should be additionally trained in the areas listed in Section 3.

7. The corresponding changes in the organisational plans, basic and advanced training schedules of the licence holder 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 (GMBl) 1994, page 366)

3.53 Guideline relating to the contents of the examination of the technical qualification of responsible shift personnel in research reactors of 14 November 1997 (Joint Ministerial Gazette (GMBl) 1997, page 794)

These guidelines apply to 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 proof of technical qualification:

1. The requirements relating to the specific training and the practical experience of the staff of the management, other senior staff and the responsible shift personnel (Section 2.1 of Guideline 3.3 and 3.53 respectively) depend on the state of the facility. As long as there is still nuclear fuel in the facility, the requirements of Guideline 3.3 and 3.53 continue to apply. After removal of the nuclear fuel from the facility, the requirements for proof of technical qualification can be reduced by the knowledge about energy release and thermohydraulics, nuclear safety, the behaviour of the research reactor during normal and abnormal operation as well as the safety-relevant events.

2. Radiation protection officers must continue to be appointed according to Guideline 3.61. The question of the continuous presence of a radiation protection officer at the facility under decommissioning can be decided during the course of the licensing procedure. Depending on the progress of the decommissioning work, in particular if shift operation is changed or abandoned, an on-call system may be sufficient.

3. The competent nuclear authority has to decide whether, depending on the stage of decommissioning reached, shift leaders, reactor operators and control panel operators as well as training managers are still required as responsible persons.

4. The remaining proofs of technical qualification can be reduced in respect of the subjects of energy release and thermohydraulics as well as plant operation.

Training at the nuclear power plant simulator can largely be dispensed with, depending on the operating processes and malfunctions or incidents still possible in the nuclear power plant.

2. After removal of the nuclear fuel from the facility, changes in the operational organisation can be implemented due to the reduced hazard potential, which may have the effect that some of the responsible functions stated in Sections 1.3.1 to 1.3.7 of Guideline 3.2 are no longer permanently required (e.g. reactor operator). For the remaining responsible personnel, proof of technical qualification is still required. The scope of the proof of technical qualification for the still necessary responsible personnel must be adapted to the current operational organisation, the changed potential hazards of the facility and the changed task structure (decommissioning and disassembly of systems, decontamination, radiation protection).

It is also necessary to adapt the maintenance of technical qualification to the changed framework conditions. In this respect, lessons learned from operational experience in the dismantling of comparable facilities are also to be imparted.

3. After removal of the nuclear fuel from the facility, it is no longer necessary to include nuclear physics, energy release and thermohydraulics in the proof of the technical qualification of the remaining responsible personnel or those newly recruited.

In view of the changed 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,
- waste water 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, proof of technical qualification and maintenance of technical qualification are:

- specific dismantling know-how regarding dismantling methods, decontamination procedures,
Knowledge relating to decontamination procedures, dismantling methods and treatment of the materials as well as knowledge specifically relating to decommissioning in the areas of licensing and administrative measures should be added.

3.61 Guideline for the technical qualification of radiation protection officers at installations for fission of nuclear fuels of 20 February 2014 (Joint Ministerial Gazette (GMBl) 2014, page 289)

This guideline is also applicable during decommissioning and safe enclosure. In view of the decreasing scope at these stages, reference can be made to Section 4 according to which exceptions from the requirements may be made. In particular, the training content should be adapted to the tasks to be fulfilled then.

3.71 Guideline relating to the technical qualification of responsible personnel in facilities for the production of fuel elements for nuclear power plants of 30 November 1995 (Joint Ministerial Gazette (GMBl) 1996, page 29)

This guideline applies to the operation of facilities for the production of uranium dioxide and uranium/plutonium mixed oxide fuel assemblies for nuclear power plants. The guideline refers neither directly nor indirectly to the decommissioning procedure. The following considerations should be sufficient for the proof of technical qualification.

Staff of the management and other senior staff (Sections 2.1 and 2.2) are generally still present during the decommissioning work. Once the facility has been emptied of nuclear fuel, the requirements for the specific training and practical experience of this staff (Sections 3.1 and 3.2 of the guideline) can be reduced in respect of plant-specific knowledge relating to the behaviour of the fabrication facilities during normal and abnormal operation.

Knowledge relating to dismantling methods, decontamination procedures and treatment of the materials as well as knowledge specifically relating to decommissioning in the areas of licensing and administrative measures should be added.

Comments on the KTA safety standards:

Safety standard KTA 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: Section 7 “Requirements Pertaining to the Operating Manual, Part 2” (operation of the overall plant), Section 8 “Requirements Pertaining to the Operating Manual, Part 3” (design basis accidents) and Section 9 “Requirements Pertaining to the Operating Manual, Part 4” (systems operation).

Re: Section 6: The plant regulations are to be adapted according to the selected operational organisation. An additional waste and residue regulation is recommended.

Re: Section 7.2 “Safety-related Limit Values – SSp”: This part is to be adapted to the special conditions of the decommissioning project. In particular, the safety-relevant limit values concerning the emission of radioactive substances via the water and air path as well as the reporting criteria and the obligations imposed by the authorities must be included. The clearance criteria for radioactive substances are to be incorporated.

Re: Section 8: The design basis accidents to be considered are to be adapted to the special conditions of the decommissioning project.
This applies, in particular, to the principles laid down in KTA 1404.

Sections 3 and 4 of the standards and the retention periods according to Tables 4 and 4-2 are applicable to decommissioning projects.

The documentation should include a description of the condition of the facility changing during the decommissioning process in order to allow an assessment of the actual condition of the facility.

This documentation should show that the legal prerequisites and legal principles are in place and complied with in a way which can be traced back and proven.

Safety standard KTA 1501 Stationary System for Monitoring the Local Dose Rate within Nuclear Power Plants

The measuring range and the requirements for the measuring devices in case of design basis accidents as well as the number of measuring devices are to be adapted to the special conditions of the decommissioning procedure.

In accordance with the nature of the decommissioning work, the local dose rate measurements are mainly to be performed by means of non-stationary measuring devices.

Safety standard KTA 1502 Monitoring Volumetric Activity of Radioactive Substances in the Inner Atmosphere of Nuclear Power Plants

Safety standard KTA 1502.2 Monitoring Radioactivity in the Inner Atmosphere of Nuclear Power Plants; Part 2: Nuclear Power Plants with High Temperature Reactors (in-active safety standard)

The requirements for the measuring devices in case of design basis accidents as well as the number of measuring devices are to be adapted to the special conditions of the decommissioning procedure.

In accordance with the nature of the decommissioning work, the local dose rate measurements are mainly to be performed by means of non-stationary measuring devices.

Safety standard KTA 1503.1 Monitoring the Discharge of Radioactive Gases and Airborne Radioactive Particulates; Part 1: Monitoring the Discharge of Radioactive Matter with the Stack Exhaust Air During Specified Normal Operation

This standard is to be applied. Measurement can be limited to the radioactive substances still present given the state of the facility. The requirements in terms of redundancy and electricity supply can be adapted to the decommissioning progress.

Safety standard KTA 1506 Measuring Local Dose Rates in Exclusion Areas of Nuclear Power Plants (standard was withdrawn on 16 November 2004)

This standard is to be applied. After removal of the nuclear fuel, measurement of neutron radiation is no longer necessary.

Safety standard KTA 1507 Monitoring the Discharge of Radioactive Substances from Research Reactors

Measurement can be limited to the radioactive substances still present given the state of the facility.

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

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

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

The requirements for protection of redundancies can be reduced.

Safety standard KTA 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 safety-relevant parts of the facility where there are explosion hazards. The basic principles (3) and the general requirements (4) are to be applied but limited to the remaining parts of the facility which are still important for safety.

Safety standard KTA 2207 Flood Protection for Nuclear Power Plants

As the decommissioning work progresses, the protection goal becomes limited to the safe enclosure of the radioactive substances.

For the load combinations (Section 6), earthquakes generally do not have to be taken into account.

Safety standard KTA 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 goal is limited to the safe enclosure of the radioactive substances.

KTA safety standards 3500 Instrumentation and Reactor Protection

As long as there is still nuclear fuel in the facility, the KTA safety standards of the 3500 series are also to be applied in the decommissioning phase.

Safety standard KTA 3601 Ventilation Systems in Nuclear Power Plants

The general requirements of Section 3 are to be complied with.

After removal of the nuclear fuel, Air Conditioning Class 2 as specified in Section 4 is sufficient, since the main focus of the decommissioning work is on the safe enclosure of the radioactive substances and on maintenance of specific humidity (corrosion protection).

The negative pressure differentials and the air exchange rates are to be adapted to the requirements of the decommissioning process. Redundant design and emergency power connection are generally not required.

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

This standard applies to systems for the collection, conduction and processing of radioactively contaminated gaseous wastes 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 state of the facility.
KTA safety standards 3700 Energy and Media Supply

As long as there is still nuclear fuel in the facility, the KTA safety standards of the 3700 series are also to be applied in the decommissioning phase.

Safety standard KTA 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 referred to.

Safety standard KTA 3901 Communication Means for Nuclear Power Plants

This standard is generally to be applied in the decommissioning phase. A redundant design of the alarm and personal paging system is not necessary. For the operation of safe enclosure, permanently installed means of communication are not required for internal communication.

Safety standard KTA 3904 Control Room, Remote Shutdown Station and Local Control Stations in Nuclear Power Plants

As long as there is still nuclear fuel in the facility, safety standard KTA 3904 is also to be applied in the decommissioning phase.
### Annex 4: Application documents for decommissioning, safe enclosure and dismantling of nuclear facilities in the Federal Republic of Germany

<table>
<thead>
<tr>
<th>No.</th>
<th>Document</th>
<th>Reference</th>
<th>Content</th>
<th>Use/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Letter of application</td>
<td>§ 7 AtG</td>
<td>- name and address of applicant</td>
<td>nuclear licensing authority, authorised experts; initiation of procedure; under certain circumstances announcement and public inspection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>§ 2 AtVfV</td>
<td>- type of licence applied for</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>§ 6 AtVfV</td>
<td>- type and scope of facility and of planned decommissioning measures</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Safety report</td>
<td>§ 3(1)1 AtIV/ § 6 AtVfV</td>
<td>a) description and drawing of facility and decommissioning measures</td>
<td>nuclear licensing authority, authorised experts; especially for third parties under certain circumstances public inspection; no commercial secrets</td>
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<td></td>
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<td>§ 6 AtVfV</td>
<td>b) description and explanation decommissioning plan, safety-related principles</td>
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<td>c) provisions to fulfil §7(2)3 AtG, radiation protection measures</td>
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<td>d) description of the surrounding area and its composition</td>
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<td>e) discharges and releases of radioactive substances (§ 47 StrlSchV, § 50 StrlSchV)</td>
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<td></td>
<td>f) consequences of direct radiation and releases of radioactive substances</td>
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<tr>
<td>3</td>
<td>Supplementary plans, drawings and descriptions of</td>
<td>§ 3(1)2 AtIV/</td>
<td>If required or requested by the nuclear licensing authority, the specific issues in the safety report are supplemented by explanatory reports.</td>
<td>nuclear licensing authority, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td></td>
<td>the facility and the planned decommissioning</td>
<td></td>
<td>- explanatory report on systems and equipment which are to be decommissioned, modified or newly constructed</td>
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<td></td>
<td>techniques and measures</td>
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<td>- documentation of the status of the facility</td>
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<td>- radiological (activity inventory, local dose rates, contamination of surfaces and rooms, quantities of wastes)</td>
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<td>- explanatory reports (where applicable) concerning:</td>
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<td>- structural measures</td>
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<td>- mechanical Measures</td>
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<td>- instrumentation and control measures</td>
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<td>- electrical measures</td>
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<td></td>
<td>- administrative or organisational measures</td>
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<tr>
<td>4</td>
<td>Report on physical protection</td>
<td>§ 3(1)3 AtIV/ § 7(2)5 AtIV/</td>
<td>details on measures to prevent interference by third parties, responsibilities</td>
<td>nuclear licensing authority, authorised experts; separate submission; classified document</td>
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</tr>
<tr>
<td>5</td>
<td>Reliability and technical qualification</td>
<td>§ 3(1)4 AtVfV § 7(2)1 AtG</td>
<td>appointment of responsible persons, proof of technical qualification as defined in or according to the BMU guideline on technical qualification of nuclear power plant personnel; details on reliability</td>
<td>nuclear licensing authority, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td>6</td>
<td>Knowledge and reliability</td>
<td>§ 3(1)5 AtVfV § 7(2)2 AtG AtZüV</td>
<td>necessary knowledge and procedures for the transfer of knowledge to staff otherwise engaged; details on reliability; equally applicable to external staff</td>
<td>nuclear licensing authority, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td>7</td>
<td>List of measures relevant for safety</td>
<td>§ 3(1)6 AtVfV § 7(2)3 AtG § 50 StrlSchV</td>
<td></td>
<td>nuclear licensing authority, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td>8</td>
<td>Financial security measures</td>
<td>§ 3(1)7 AtVfV § 7(2)4 AtG § 12 AtDeckV</td>
<td>proposals for fulfilling compensation obligations</td>
<td>nuclear licensing authority, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td>9</td>
<td>Radioactive residues</td>
<td>§ 3(1)8 AtVfV § 9a AtG</td>
<td>description of the radioactive residues arising; measures for avoiding radioactive residues, for non-detrimental utilisation and disposal as waste</td>
<td>nuclear licensing authority, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td>10</td>
<td>Overriding public interests, environmental impacts</td>
<td>§ 3(1)9 AtVfV § 7(2)6 AtG</td>
<td>list of proposed measures for protecting water, air and ground; details on other environmental impacts</td>
<td>nuclear licensing authority in consultation with other relevant authorities, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td>11</td>
<td>EIA documents</td>
<td>§§ 2a, 7(4) AtG §§ 1a, 3, 4, 19b AtVfV §§ 3, 3c UVPG §§ 6 UVPG §§ 8 et seq. AtVfV §§ 6 AtVfV</td>
<td>determination of relevant environmental impacts; presentation of procedural alternatives; documents of the project developer; hearing</td>
<td>in the case of public participation and thus projects subject to environmental impact assessments</td>
</tr>
<tr>
<td>12</td>
<td>Brief description</td>
<td>§ 3(4) AtVfV § 6 AtVfV</td>
<td>summary description according to safety report</td>
<td>nuclear licensing authority, authorised experts, third parties; if public involvement is necessary; public inspection no commercial secrets</td>
</tr>
<tr>
<td>13</td>
<td>List of documents submitted</td>
<td>§ 3(4) AtVfV</td>
<td>listing; documents containing commercial secrets should be identified</td>
<td>nuclear licensing authority, authorised experts</td>
</tr>
<tr>
<td>14</td>
<td>Adaptation of operating manual and testing manual</td>
<td></td>
<td>revision according to the new state of the facility; dismantling manual</td>
<td>nuclear licensing authority, authorised experts</td>
</tr>
<tr>
<td>No.</td>
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<td>Reference</td>
<td>Content</td>
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<td>-----</td>
<td>--------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>15</td>
<td>Details on licensing notices, conditions and permissions to be withdrawn or amended</td>
<td></td>
<td>list with explanations or justification</td>
<td>nuclear licensing authority, authorised experts; commercial secrets to be identified as such</td>
</tr>
<tr>
<td>16</td>
<td>Documents required by building regulations</td>
<td>Land building code</td>
<td>Details on building and demolition activities associated with decommissioning</td>
<td>nuclear licensing authority, as the case may be the legal board of construction</td>
</tr>
<tr>
<td>17</td>
<td>Documents required by the Federal Immission Control Act (BImSchG)</td>
<td>§ 7(2)6 and § 8 AtG</td>
<td>Documents on facilities subject to licensing according to § 4 BImSchG</td>
<td>nuclear licensing authority, competent Land authority for immission control</td>
</tr>
<tr>
<td>18</td>
<td>Documents relating to water law</td>
<td>Federal Water Act (WHG)</td>
<td>Application for water licence and permit, if modification required</td>
<td>water authority, nuclear licensing authority</td>
</tr>
</tbody>
</table>