Safety Standards

of the

Nuclear Safety Standards Commission (KTA)

KTA 3303 (2015-11)

Heat Removal Systems for Fuel Pools in Nuclear Power Plants with Light Water Reactors

(Wärmeabfuhrsysteme für Brennelementlagerbecken von Kernkraftwerken mit Leichtwasserreaktoren)

The previous version of this safety standard was issued in 1990-06

If there is any doubt regarding the information contained in this translation, the German wording shall apply.

Editor:
KTA-Geschaeftsstelle
c/o Bundesamt fuer kerntechnische Entsorgungssicherheit (BfE)
Willy-Brandt-Str. 5 • 38226 Salzgitter • Germany
Telephone +49 (0) 30 18333-1621 • Telefax +49 (0) 30 18333-1625

KTA SAFETY STANDARD

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Contents

Comments by the Editor:

Taking into account the meaning and usage of auxiliary verbs in the German language, in this translation the following agreements are effective:

shall	indicates a mandatory requirement,
shall basically	is used in the case of mandatory requirements to which specific exceptions (and only those!) are permitted. It is a requirement of the KTA that these exceptions - other than those in the case of **shall normally** - are specified in the text of the safety standard,
shall normally	indicates a requirement to which exceptions are allowed. However, exceptions used shall be substantiated during the licensing procedure,
should	indicates a recommendation or an example of good practice,
may	indicates an acceptable or permissible method within the scope of the present safety standard.

Basic Principles

(1) The safety standards of the Nuclear Safety Standards Commission (KTA) have the objective to specify safety-related requirements, compliance of which provides the necessary precautions in accordance with the state of the art in science and technology against damage arising from the construction and operation of the facility (Sec. 7 para. 2 subpara. 3 Atomic Energy Act - AtG) in order to achieve the fundamental safety functions specified in the Atomic Energy Act and the Radiological Protection Ordinance (StrlSchV) and further detailed in the Safety Requirements for Nuclear Power Plants as well as in the Interpretations of the Safety Requirements for Nuclear Power Plants.

(2) The systems for removing the decay heat generated in the fuel pool are essential components of the equipment for the storage and handling of irradiated fuel assemblies.

(3) Any events connected with a failure of the cooling of the fuel pool occur at low temperatures, pressures and decay energies. Although cooling the fuel pools is a continuous demand case, in case of failure of the cooling considerably longer intervention times are available before occurrence of undesirable conditions than are available for the demand case of safety systems when an accident occurs in the reactor during power operation. Therefore, lower safety-related requirements apply to the Fuel Pool Heat Removal systems – in short: FPHR-systems – than to the safety system for the control and mitigation of accidents in the reactor.

Note:

The FPHR-systems comprise all components needed for the heat removal from the fuel pool to the heat sink. This can include parts of other systems (e.g., the residual heat removal system) that may be used to perform the function of fuel pool cooling.

(4) The requirements for the FPHR-systems are detailed in the present safety standard; these are, especially, the temperature limits not to be exceeded in the fuel pool.

(5) Additional requirements regarding storage and handling and refueling are specified in safety standard KTA 3602. Requirements regarding criticality safety during refueling are specified in safety standard KTA 3107. In addition, safety standard KTA 2502 specifies the requirements regarding the mechanical design of fuel pools, i.e., requirements with respect to the mechanical engineering and structural design as well as to the concrete structure of the fuel pool. In as far as system-technological connections exist between FPHR-systems and the residual heat removal systems for transferring residual heat from the reactor coolant system into a heat sink, the safety standard KTA 3301 shall be observed regarding the function of residual heat removal.

1 Scope

(1) This safety standard applies to water-cooled fuel pool heat removal systems – in short: FPHR-systems – in reactor buildings of nuclear power plants with light water reactors. It specifies the requirements which shall be considered for the design, construction and operation of these systems as well as for the fuel pools to ensure sufficient fuel pool cooling in all demand cases to be assumed.

(2) The requirements specified in this safety standard shall also be applied to the auxiliary, supply and energy systems including the associated instrumentation and controls, in as far as their functions are necessary for the heat removal from fuel pools.

(3) Not within the scope of the present safety standard are requirements regarding the design and construction of fuel pools or regarding the individual components of the FPHR-systems unless the requirements result from the system-technological requirements.

Note:

Requirements specific to the fuel pool are dealt with in safety standards KTA 2502 and KTA 3602.

(4) Likewise, not within the scope of the present safety standard are any requirements regarding the plant-internal accident management that concern heat removal from the fuel pool.

2 Definitions

Note:

The terms “decay energy”, “operating time”, “decay time” and “power histogram” are used in accordance with the definitions of DIN 25463-1; the terms “refueling” and “shuffling of fuel assemblies” are used as defined in safety standard KTA 3602. Furthermore, certain terms are used as defined in safety standard KTA 3301.

(1) Fuel pool water temperature

The fuel pool water temperature is the mixture temperature at a sufficient depth close to the fuel pool wall.

Note:

Experience shows that temperatures measured in the fuel pool and in the extraction pipe leading to the fuel pool cooling system differ only slightly; therefore, design and control can be based on the fuel pool water temperature measured in the extraction pipe.

(2) Fuel assembly partial-discharge quantity

The fuel assembly partial-discharge quantity is the number of those fuel assemblies which, at the end of a core cycle, are not scheduled to be used in the next core cycle. Therefore, during refueling, they must be transferred from the reactor core into the fuel pool where they will remain until their removal or re-use.

(3) Auxiliary measures

Auxiliary measures are measures taken for the duration of the unavailability of an equipment to ensure that its safety-related function is upheld reliably by other means.

(3) Core discharge

Core discharge is the discharge of all fuel assemblies from the reactor core into the fuel pool.

3 Demand Cases and Assigned Tasks

3.1 Assigned Tasks

(1) When the fuel pool is charged with irradiated fuel assemblies, the FPHR-systems have the tasks, specifically regarding

a) working conditions of the plant personnel with respect to ambient conditions and radiation exposure, particularly during the handling of fuel assemblies,

b) maintaining fuel pool integrity, and

c) confinement of radioactive substances,

of ensuring a sufficient heat removal from the fuel pool under all plant conditions (e.g., specified normal operation, design-basis accidents of the power plant and of the FPHR-systems, internal and external events as well as very rare human induced external hazards).

(2) The FPHR-systems may be applied for other tasks, provided, even then the requirements specified in the present safety standard are upheld.

3.2 Demand cases

The FPHR-systems shall be designed for the following demand cases:

a) Partial core discharge (power operation):

Cooling the fuel assembly partial-discharge quantities starting with inserting the fuel pool partitioning gate, continuing during reactor startup, during power operation, during reactor shutdown, ending when the fuel pool partitioning gate is again pulled up.

b) Refueling (charging and discharging)

Fuel pool cooling during refueling of fuel assemblies where the fuel pool is connected to the reactor pressure vessel (pulled up fuel pool partitioning gate).

c) Core discharge

Fuel pool cooling after core discharge where the fuel pool is isolated from the reactor pressure vessel (inserted fuel pool partitioning gate).

Note:

In case of the demand cases a) and b), the decay energy needs to be discharged both from the reactor pressure vessel as from the fuel pool. The residual heat removal from the reactor pressure vessel is dealt with in safety standard KTA 3301.

4 Design

4.1 Determining the Thermal Energy to be Removed

4.1.1 Thermal energy to be considered

(1) The thermal energy to be removed for the various demand cases, each, shall be determined based on the condition in which the maximum decay energy is released within the frame of the maximum scheduled pool allocation. For the demand cases specified under Section 3.2, items b) and c), the overall thermal energy released shall be calculated from the decay energy of the discharged core plus the decay energy of the fuel assembly partial-discharge quantities in the fuel pool.

(2) The thermal input from components of the FPHR-systems shall be considered. The heat discharged from the fuel pool because of evaporation, convection, heat radiation and heat conduction may be taken into account.

4.1.2 Decay energy

4.1.2.1 Calculation procedure

The decay energy of the fuel assemblies stored in the fuel pool shall be calculated in accordance with standard series DIN 25463. In this context, the contribution of the fission products shall be accounted for by applying a margin of error equal to one times the standard deviation (1 x sigma). In the case of very rare human induced external hazards, no margin of error is required regarding the contribution of the fission products.

4.1.2.2 Operating parameters

The operating time assumed for the fuel assemblies shall be the residence time of the fuel assemblies in the reactor lasting until the end of the cycle prior to fuel discharge. The power history and the development of the fuel composition of the fuel assemblies (power histogram) shall be based on the respective fuel concept and fuel charging concept.

4.1.2.3 Decay times

(1) The calculation of the relevant decay times shall be based on the shortest possible time intervals between shutdown and the subsequent design-significant points in time; in this context, the boundary conditions to be used shall either be practice-oriented or those that are to be specified in the operating manual.

(2) The design-significant points in time to be used for calculating the decay energy are:

a) t_T (inserting the fuel pool partitioning gate after completion of refueling)
Point in time of isolating the fuel pool by inserting the fuel pool partitioning gate after completion of refueling.

b) t_L (power operation)
Point in time of resuming power operation after completion of refueling. In case the FPHR-systems are interconnected with the residual heat removal systems, the most unfavorable point in time for the heat removal from the fuel pool shall be the basis used.

Note:

Because the decay energy in the reactor core builds up in the course of power operation and decreases in the fuel pool, the most unfavorable point in time for the heat removal in case of an interconnection may occur several days after the begin of power operation.

c) t_{BEW} (charging and discharging of fuel)
Point in time of most unfavorable fuel pool allocation when the fuel pool partitioning gate is still open.

d) t_E (core discharge)
Point in time of maximum energy release in the fuel pool when the reactor core is fully discharged into the fuel pool and the fuel pool partitioning gate is inserted.

4.2 Fuel Pool Water Temperatures not to be exceeded

4.2.1 Temperature levels

(1) The design of the FPHR-systems shall be based on the following fuel pool temperatures

a) T_1 = 45 °C

b) T_2 = 60 °C

c) T_3 = 80 °C

Notes:

The specified temperatures T_1, T_2 and T_3 are identical with the temperatures T_1, T_2 and T_3 that are specified in safety standard KTA 2502 and represent the design basis for the mechanical design of the fuel pool as specified in safety standard KTA 2502.

T_1 is the fuel pool temperature not to be exceeded during specified normal operation with regard to the working conditions of the operating personnel, i.e. the temperature at which unrestricted work on and at the fuel pool is possible and admissible.

T_2 is the temperature of an abnormal fuel pool operation. It is specified as 60 °C because it can be assumed that, up to 60 °C with the associated steam moisture, the ventilation systems will continue to function, and necessary tasks can be performed.

T_3 is the fuel pool temperature limit not to be exceeded during design basis accidents as well as during internal and external events. Regarding very rare human induced external hazards, cf. Section 4.2.6.

(2) Deviating from para. (1), the temperature T_3 may be higher than 80 °C, provided, a corresponding mechanical design is chosen for the fuel pool (concrete, steel cladding of the pool wall) and for the FPHR-systems including the connected, bordering non-isolatable systems.

4.2.2 Specified Normal Operation

4.2.2.1 Normal operation

(1) The FPHR-systems shall be designed such that a pool water temperature lower than or equal T_1 is maintained.

(2) Planned inspection and servicing measures that lead to an unavailability of one or more trains are admissible, provided, it is proven that the temperature T_1 is not exceeded.

4.2.2.2 Abnormal operation

For the events to be assumed in the FPHR-systems at the Level of Defense 2 in accordance with SiAnf, a pool water temperature lower than or equal T_2 shall be maintained.

4.2.3 Design basis accidents of the reactor

(1) It shall be possible to maintain a pool water temperature lower than or equal T_3.

(2) It shall be assumed that one train on which it is planned to perform inspection and servicing tasks during normal system conditions is not operationally available.

4.2.4 Design basis accidents of FPHR-systems

(1) For the events to be assumed in the FPHR-systems at the Level of Defense 3 in accordance with SiAnf, a pool water temperature lower than or equal T_3 shall be maintained.

Note:

Other than with the design-basis accidents to be assumed for the reactor during power operation, graded safety-related requirements apply to the assumed failures of the FPHR-systems. Event sequences of the reactor plant require the immediate availability of the equipment ensuring subcriticality and the removal of stored and residual heat. In comparison, the transients after failures of the FPHR-systems proceed slowly and at low pressures and temperatures. Therefore, a considerably longer non-intervention time is available for the mitigation of event-independent single failures in the FPHR-systems than is available for the demand case of, e.g., residual heat removal systems of the reactor plant. Furthermore, the function of fuel pool cooling is a permanent operational demand case for the FPHR-systems, thus, continuously showing the operational availability of the fuel pool cooling.

(2) If it can be demonstrated for the design-basis accidents of FPHR-systems including the application of the single failure concept that the non-intervention time before the temperature T_3 is reached is at least 10 hours, it may be assumed that one of the unavailable trains is again available, provided, sufficient resources (e.g., sufficient and qualified maintenance personnel, supply of spare parts) are available on the plant site.

(3) If servicing tasks are needed for ensuring the functional operability of the FPHR-systems, they may be performed in all operating phases, provided, the following conditions in accordance with SiAnf, Annex 4, No. 3.3.2, are met:

a) the servicing measure requires only a brief unavailability of one fuel pool cooling train, and

b) the fuel pool cooling train concerned can be quickly restored to the operation condition in a demand case (i.e., events at the Level of Defense 3 in the FPHR-systems).

(4) Auxiliary measures or other measures for restoring the availability of a train may be considered in the event analysis, provided, these measures can be performed event-dependently before the temperature T_3 is reached.

4.2.5 Natural external events, and internal events

(1) A pool-water temperature lower or equal to T_3 shall not be exceeded.

(2) The requirements of Section 4.2.4, paras. (2) through (4) shall be fulfilled.

4.2.6 Very rare human induced external hazard

(1) In the case of very rare human induced external hazards which, due to their low probability of occurrence, are not design-basis accidents, for which, however, risk-minimizing measures must be provided (e.g., airplane crash, pressure wave from an explosion), a fuel pool temperature lower than or equal to T_3 shall be maintained.

(2) A single failure, basically, does not need to be assumed. However, the occurrence of a single failure shall be assumed for any function that is demanded within the first 30 minutes and the effectiveness of which is necessary for achieving and maintaining a stable plant condition during the 10-hour non-intervention time.

(3) No servicing measures need to be assumed.

4.3 Boundary Conditions of the Heat Sink

4.3.1 Heat removal into bodies of water

In case of the heat removal into bodies of water (direct cooling), the highest monthly average temperature determined over several years of observation shall be used as the design-significant cooling water intake temperature.

4.3.2 Heat removal into the atmosphere

In case of the heat removal into the atmosphere via wet cooling tower facilities, the system design shall be based on the peak wet bulb temperature reached on twenty days per year on a long-term average. In case the heat is removed via dry cooling tower facilities, the reference temperature shall be selected correspondingly.

4.3.3 Availability of the heat sinks

Regarding the availability of the heat sinks, the requirements specified in safety standard KTA 3301, Secs. 6.3.1 through 6.3.4, shall be met.

5 System Concept

5.1 Basic Concept

(1) The FPHR-systems shall be designed at least as dual-train systems.

(2) The necessary instrumentation and control equipment as well as the auxiliary, supply and energy systems shall normally have a train-wise layout corresponding to that of the FPHR-systems.

(3) If systems are used both for the emergency cooling of, and the residual heat removal from the reactor core as well as for the cooling of the fuel pool, an additional fuel pool cooling train must be available. This train shall alone be able to cool the fuel pool in case of a loss-of-coolant accident in the reactor cooling circuit.

(4) When planning the system concept, particularly regarding the interconnections with other systems as well as the instrumentation and control equipment of the systems, a time-limited interruption of pool cooling may be considered. The non-intervention time will be a result of the heating-up process, starting at the operationally specified maximum temperatures – indicated, e.g., by a "temperature high" alarm – proceeding to the respective maximum admissible pool water temperature T_2 or T_3.

5.2 System-Technological Interconnections

(1) A system-technological interconnection of the heat removal from the fuel pool with other functions, in particular for other heat removal functions and for fuel pool cleaning, is admissible, provided, the requirements of the present safety standard are met.

Note:

This applies, e.g., to the following interconnections that enable a simultaneous or timely staggered operation:

a) Interconnection between the FPHR-systems and other heat removal systems during power operation.

b) Interconnection between the FPHR-systems and the residual heat removal system and use of the cooling capacity of the latter during the refueling phase.

c) Interconnection between the FPHR-systems with residual heat removal functions, e.g., for the residual heat removal from the reactor core after an external event.

d) Interconnection of the power supplies of the residual heat removal systems and the FPHR-systems in the case of a failure of the auxiliary power supply.

(2) In as far as the FPHR-systems including the associated auxiliary, supply and energy systems are interconnected with other systems for which failure assumptions for certain events are made (e.g., in accordance with the single failure concept or with safety standard KTA 3301), those system parts assumed to be operationally unavailable are regarded as having also failed for the heat removal from the fuel pool. In this case, an additional failure of the FPHR-systems need not be assumed.

(3) The alternating deployment of an active component for multiple functions shall normally be avoided.

5.3 Coolant Makeup of the Fuel Pool

(1) The water losses caused by evaporation and operational leakages (e.g., stuffing boxes, pool lining) or operational procedures, shall be replenished such that the minimum water level is maintained.

(2) For the refilling of water losses after leakage accidents, a possibility for water replenishment shall be available. In this context, auxiliary measures or measures to reestablish functional capabilities may be considered, provided, these measures can be performed event-dependently before the temperature T_3 is reached.

Note:

Requirements regarding the boron concentration of the fuel pool are specified in safety standard KTA 3602, Sec. 4.2.6.

(3) Protection against unintentional overfilling shall be provided, e.g., by means of sufficient overflow cross sections or electro-technical surveillance measures (cf. Section 7.2).

5.4 Penetration of the Containment Vessel

(1) All pipes of the FPHR-systems which penetrate the containment vessel and serve the purpose of heat removal from the fuel pool after loss-of-coolant accidents shall be provided with isolating equipment as specified in safety standard KTA 3404.

(2) Pipes that have no fuel pool heat removal function after loss-of-coolant accidents but are connected to pipes of the FPHR-systems specified under para. (1) outside of the containment vessel shall be included in the penetration isolation as specified in safety standard KTA 3404.

5.5 Radioactivity Barriers toward the Heat Sink

(1) Any radioactivity discharge via the FPHR-systems to the heat sink shall be prevented.

Note:

It is common practice to provide two radioactivity barriers. The first barrier may, e.g., be a passive component (heat exchanger), the second barrier may be second passive component or a corresponding pressure-staggering arrangement.

(2) Monitoring for leakages and radioactive materials shall be provided as specified in safety standard KTA 1504.

6 Requirements for the Fuel Pool and for Components of the FPHR-Systems

6.1 Design

(1) The design of the fuel pool and of the FPHR-system components shall be based on the requirements specified under Section 4. The boundary and ambient conditions to be applied shall be those to be anticipated for the various demand cases. Event-related increased operating pressures and temperatures as well as changed ambient conditions shall be taken into account.

(2) The mechanical design of the fuel pool as specified in safety standard KTA 2502 shall be based on the most unfavorable temporal sequence – both for heating up as for cooling down.

(3) The electric drive mechanisms shall be designed as specified in safety standard KTA 3504.

(4) The effects of the coolant properties (e.g., radioactivity, boron and oxygen content) and their interaction with the materials shall be considered in specifying the requirements.

(5) Components, the function of which are required for the control and mitigation of external events, shall be designed to cope with resulting stresses. Branch circuits that are not designed against these events shall be isolatable under the respective conditions. Spatial separation of redundant devices may be considered as sufficient protection, provided, the stresses are limited to partial areas of the power plant.

6.2 Physical Arrangement

(1) As far as possible, the components of the FPHR-systems shall be located outside of the containment vessel so that, if necessary, they are accessible for actuation and maintenance measures.

Note:

With regard to the maintenance measures after a loss-of-coolant accident, the requirements specified in safety standard KTA 1301.1, Sec. 9.2.3, shall be observed.

(2) Suction and feed nozzles of the fuel pool cooling system shall be physically arranged and constructed in such a way that the circulation inside the fuel pool is supported and a short-circuit flow is avoided.

(3) Any vortex formation involving air intake shall be prevented.

(4) The suction lines of the fuel pool cooling system shall be physically arranged in such a way that, event-dependently, perfect intake conditions exist for the pumps.

(5) Suction nozzles and feed nozzles shall be constructed such that the flow velocity is sufficiently low not to impair the transparency of the water due to wave formation.

(6) To maintain the cooling capacity in the case of leakages and regarding repairs on the first isolation valves, an isolation capability or an equivalent auxiliary measure shall be provided for the suction nozzles and feed nozzles of the fuel pool.

(7) Pipes connected to the fuel pool that are not involved in cooling the fuel pool shall be connected to the fuel pool in such a way that their failure does not detrimentally impair fuel pool cooling.

(8) Pipes inside the fuel pool shall be physically arranged or provided with equipment such that siphoning effects cannot lead to an inadmissible decrease of the fuel pool water level.

(9) The components of the FPHR-systems shall be physically arranged such that the fuel pool cooling is ensured in case of

a) mechanical impacts (e.g., by the failure of adjacent high-energy pipes or by transport procedures),

b) a plant-internal fire, or

c) a plant-internal flooding.

7 Operation and Surveillance

7.1 Operation

(1) It is permissible to provide manual controls for the FPHR-systems. The controls may be designed to be component-related (i.e., individual actuation) or, in the case of functionally related groups of components, to be group-related (i.e., group actuation).

(2) The actuating elements for the FPHR-systems shall be located in the control room. Regarding a control room failure, the necessary actuating elements for ensuring fuel pool cooling shall also be available elsewhere, e.g., in the remote shutdown station or in a local control station.

7.2 Surveillance

(1) The measuring points "Fuel pool water temperature" and "Fuel pool water level" shall be designed as specified in safety standard KTA 3502. If the limit temperature T_1 is exceeded or the operational water level limits are reached, Class II hazard alarms as specified in safety standard KTA 3501 shall be generated. If the limit temperature T_2 is exceeded or if the pool level has decreased to the minimum water level, a Class I hazard alarm as specified in safety standard KTA 3501 shall be generated.

(2) Regarding the operational surveillance of the effectiveness of fuel pool cooling, additional suitable variables of state shall be monitored.

8 Maintenance

8.1 Repairs

In case of a failure of a component of the FPHR-systems, repairs shall normally be conducted immediately after detection of the failure.

8.2 Servicing and Inspection

(1) The pool water temperature T_1 shall not be exceeded during servicing and inspection tasks.

(2) Servicing and inspection tasks that lead to an interruption of the operational availability of a component of the FPHR-systems shall normally be conducted preferably at a time when the thermal energy to be removed from the fuel pool is as low as possible, e.g., towards the end of the operating cycle of the power plant.

9 Functional Tests

Regular functional tests shall be conducted on all active components of the FPHR-systems. These shall normally be performed every four to eight weeks. These tests may also be performed by means of operational switch-overs between the trains.

Appendix A

Comprehensive Design Requirements of the Fuel Pool Heat Removal Systems (FPHR-systems)

System Conditions	Demand Case	Design-Decisive Point in Time 1)	Fuel Pool Water Temperatures not to be exceeded 2)
Normal Operation	Partial core discharge Refueling Core discharge	t_T t_{BEW} t_E	T_1
Abnormal Operation	Partial core discharge Refueling Core discharge	t_T t_{BEW} t_E	T_2
Accidents; Internal and External Events; Very Rare Human Induced External Hazards (Required Values)	Partial core discharge Refueling Core discharge	t_T or t_L t_{BEW} t_E	T_3

1) Nomenclature:

t_{BEW}: Point in time of most unfavorable fuel pool allocation when the fuel pool partitioning gate is still pulled up.

t_E: Point in time of maximum energy release in the fuel pool when the reactor core is fully discharged into the fuel pool and the fuel pool partitioning gate is inserted.

t_L: Point in time of resuming power operation after completion of refueling. In case the FPHR-systems are interconnected with the residual heat removal systems, the most unfavorable point in time for the heat removal from the fuel pool shall be used.

t_T: Point in time of isolating the fuel pool by closing the fuel pool partitioning gate after completion of refueling.

2) The temperature levels T_1, T_2, und T_3 are specified under Section 4.2.1, para. (1). The values are T_1 = 45 °C, T_2 = 60 °C and T_3 = 80 °C; as specified in Section 4.2.1, para. (2), the temperature T_3 may be higher than 80 °C, provided, the fuel pool (concrete, pool wall steel cladding) and the FPHR-systems are themselves designed for the higher temperature.

Appendix B

Regulations Referred to in the Present Safety Standard

(Regulations referred to in the present safety standard are valid only in the versions cited below. Regulations which are referred to within these regulations are valid only in the version that was valid when the latter regulations were established or issued.)

AtG		Act on the peaceful utilization of atomic energy and the protection against its hazards (Atomic Energy Act – AtG) of December 23, 1959, revised version of July 15, 1985 (BGBl. I, p. 1565), most recently changed by Article 307 of the Act of August 31, 2015 (BGBl. I 2015, No. 35, p. 1474)
StrlSchV		Ordinance on the protection from damage by ionizing radiation (Radiological Protection Ordinance – StrlSchV) of July 20, 2001 (BGBl. I, p. 1714; 2002 I, p. 1459), most recently changed by Article 5 of the Act of December 11, 2014 (BGBl. I, p. 2010)
SiAnf	(2015-03)	Safety requirements for nuclear power plants of November 22, 2012, revised version of March 3, 2015 (BAnz AT of March 30, 2015 B2)
SiAnf-Interpretations	(2015-03)	Interpretations of the safety requirements for nuclear power plants of November 22, 2012, revised version of March 3, 2015 (BAnz AT of March 30, 2015 B3)
KTA 1504	(2015-11)	Monitoring and assessing the discharge of radioactive substances with water
KTA 2502	(2011-11)	Mechanical design of fuel assembly storage pools in nuclear power plants with light water reactors
KTA 3107	(2012-11)	Nuclear criticality safety requirements during refueling, Draft version
KTA 3301	(2015-11)	Residual heat removal systems of light water reactors
KTA 3404	(2013-11)	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
KTA 3501	(2015-11)	Reactor protection system and monitoring equipment of the safety system
KTA 3502	(2012-11)	Accident measuring systems
KTA 3504	(2006-11)	Electrical drive mechanisms of the safety system in nuclear power plants
KTA 3602	(2003-11)	Storage and handling of fuel assemblies and associated items in nuclear power plants with light water reactors
DIN 25463-1	(2014-02)	Calculation of the decay power in nuclear fuels of light water reactors - Part 1: Uranium oxide nuclear fuel for pressurized water reactors
DIN 25463-2	(2014-02)	Calculation of the decay power in nuclear fuels of light water reactors - Part 2: Mixed-uranium-plutonium oxide (MOX) nuclear fuel for pressurized water reactors