Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 3603 (2017-11)

Facilities for Treating Radioactively Contaminated Water in Nuclear Power Plants

(Anlagen zur Behandlung von radioaktiv kontaminiertem Wasser in Kernkraftwerken)

The previous versions of this safety standard were issued in 1991-06 and 2009-11

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KTA SAFETY STANDARD

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Contents

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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 this 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) It must be certified that the measures regarding damage precaution pursuant to Sec. 7 para. 2 no. 3 AtG are met by, among others, the equipment for retaining liquid radioactive substances within the provided confinements, for their handling and controlled conduction inside the nuclear power plant and for their controlled discharge via the provided paths. In this context, the facilities for treating radioactively contaminated water are part of the equipment that, pursuant to Sec. 33 para. 1 StrlSchV and with regard to the objectives specified in paragraph 3, must be provided by the radiological protection supervisor.

(3) The present safety standard specifies requirements for the design of the facilities under paragraph 2 with regard to process engineering and construction, to the structural arrangement and to the tests and inspections which, together, serve to attain, in particular, the following objectives:

a) keeping any radiation exposure or contamination of humans or of the environment as low as possible, even below the limits specified in the Radiological Protection Ordinance (Sec. 6 para. 2 StrlSchV), taking the state of science and technology and all aspects of the individual case into consideration,

b) ensuring that no radioactive substances will be discharged uncontrolled into the environment (Sec. 47 para. 1 sentence 2 StrlSchV), and

c) ensuring that the maximum values specified by the authorities pursuant to Sec. 47 para. 3 StrlSchV for the intentional discharge of radioactive substances with water are not exceeded.

(4) In addition to the requirements of this safety standard, the Act on Management of Water Resources (Water Resources Management Act - WHG) and the respective Water Management Act of the respective state (Land) shall be observed. Pursuant to these requirements – and irrespective of the nuclear licenses – the discharge of waste water into bodies of water requires a license under the Water Resources Management Act (Secs. 2 and 8 WHG). In this context, it shall be observed that

a) the burden of the radioactive substances in the waste water shall be kept as low as is possible under consideration of the requirements of the state of the art (Sec. 7a para. 1 WHG), and

b) a pollution of the body of water or any other detrimental alteration of its characteristics is prevented (Sec. 1a Para. 2 WHG).

1 Scope

(1) This safety standard applies to the facilities for treating radioactively contaminated water arising in nuclear power plants with light water reactors. These facilities have the task of collecting the radioactively contaminated water produced and treating it such that it may be, either, put to further use in the nuclear power plant or discharged from a discharge tank to the main water source in a controlled way.

Note:

In case of a possible recovery of the treated water for further use in the power plant, the corresponding water quality specifications for the individual application shall be observed.

(2) With regard to the components for the storage of radioactive concentrates, additional requirements are specified in this safety standard which supplement those of safety standard KTA 3604.

(3) This safety standard does not apply to facilities for cleaning the primary coolant, nor to component drain systems, nor to the treatment of radioactive concentrates, nor to the fuel assembly storage pool purification systems.

Note:

Requirements for the primary coolant clean-up systems are specified in DIN 25 476, and for the treatment of radioactive concentrates in KTA 3604. No standards are available for fuel assembly storage pool purification systems.

2 Definitions

(1) Treating of radioactively contaminated water

Treating of radioactively contaminated water comprises all measures that can reduce the concentration of radioactive pollutants, and includes the collection and storage of this water.

(2) Specified normal operation

The specified normal operation encompasses

a) operating processes for which the plant, assuming the able function of all systems (fault-free condition), is intended and suited (normal operation),

b) operating processes which occur in the event of plant component or system malfunction (fault condition), in so far as safety related reasons do not oppose continued operation (abnormal operation),

c) maintenance procedures (inspection, servicing, repair).

Note:

The term “plant” in this definition is taken as being identical to the term “nuclear power plant”. In the following (German) text of this safety standard, however, “plant” always indicates “plant for treating radioactively contaminated water”.

(Comment by the editor:
This note applies only to the German original. In its English translation, the term “plant” is correspondingly translated as “facility” or as “facility for treating radioactively contaminated water” if necessary for clarification.)

(3) Decontamination factor

Decontamination factor is the ratio of the concentration of the radioactive substances in the initial water to their concentration in the treated water. In variance from this definition, the decontamination factor of an evaporator facility is the ratio of the concentration in the evaporator cavity to that of the distillate.

(4) Radioactive concentrates

Radioactive concentrates are radioactive wastes in fluid form from facilities for treating radioactively contaminated water (e.g., evaporator concentrates, filtration residues from mechanical filters, used-up materials from ion exchangers).

(5) Discharge tank

A discharge tank is a vessel from which the water is discharged into the main water source after the decision measurement was performed.

3 Process Engineering Design

3.1 General Requirements

(1) The radioactively contaminated water shall be treated such that, when discharging treated water from a discharge tank, the activity concentration in accordance with safety standard KTA 1504 is not exceeded.

(2) The monitoring and detailed assessment of discharges shall be carried out in accordance with the requirements in accordance with safety standard KTA 1504.

(3) With regard to protecting the plant personnel against ionizing radiation, the design and arrangement of the facilities shall meet the requirements in accordance with safety standards KTA 1301.1 and KTA 1301.2.

(4) The nuclear-power-plant-related conditions (e.g. leakages inside the condenser or steam generator) influencing the quantity of radioactively contaminated water, and the plant-site-related conditions (e.g. water level of the main water source) shall be taken into account.

(5) The water accumulating from back-flushing or regeneration and from a subsequent purging of the steam generator blowdown system of nuclear power plants with pressurized water reactors shall be monitored and, if the value of the Cs 137-equivalent is higher than $2 \cdot 10^6$ Bq/m^3, shall be fed into the facilities for treating radioactively contaminated water.

(6) The water accumulated from back-flushing or regeneration and from the subsequent purging of the condensate polishing system of nuclear power plants with pressurized water reactors shall be monitored prior to a discharge and, if the value of the Cs 137-equivalent is higher than $2 \cdot 10^6$ Bq/m^3, shall be fed into the facilities for treating radioactively contaminated water. A connecting line to these facilities is not required, if it is ensured by another measures (e.g. operating procedure) that the Cs 137-equivalent will not exceed the value of $2 \cdot 10^6$ Bq/m^3.

(7) The water accumulated from back-flushing or regeneration and from the subsequent purging of the condensate polishing system of nuclear power plants with boiling water reactors shall be collected fed to facilities for treatment or recirculated back into the plant.

3.2 Design and Capacity of the Facilities for Treating Radioactively Contaminated Water

(1) The design of the facilities shall allow for a separate collection and treatment of the different waters (e.g., corresponding to the specific activity or to the chemical composition).

Note:

Typical sources of waste water in nuclear power plants are listed in **Tables 3-1** and **3-2**. Usually, the water is collected separately according to water to be evaporated and water to be treated mechanically. In addition, in nuclear power plants with boiling water reactors, the water with a low conductivity is collected separately and treated by ion exchanging methods.

(2) In nuclear power plants with light water reactors it shall be possible to clean the waste water by evaporation procedures and, basically, also by mechanical means (centrifuges or filters). Mechanically cleaning facilities are not required if the capacity of the evaporation facility is sufficiently dimensioned. Nuclear power plants with boiling water reactors shall, additionally, be provided with ion exchange facilities for treating radioactively contaminated water with low conductivity.

(3) The capacity of the facilities shall be individually specified under consideration of the overall concept of the facility and of the amount of accumulated waste water during specified normal operation. In this context, special attention shall be paid to the operational mode of the facilities (e.g., shift operation, five-day operation, degree of operation, where applicable multi-block power plant). **Table 3-3** lists corresponding orientation values for the case of a nuclear power plant with an electric power greater than 1100 MW.

Note:

These orientation values are based on the assumptions that the annually accumulated waste water can reach 20000 m^3 in a nuclear power plant with a pressurized water reactor, and 40000 m³ in a nuclear power plant with a boiling water reactor. This takes into account that on individual days – especially during the major inspection of the nuclear power plant – the quantities accumulated may be above-average.

Waste Waters	Water Characteristics
Sump water from power plant compartments Water from the treatment of concentrates Laboratory and decontamination water	Higher level of activity concentration, water contains boric acid
Sump water from power plant compartments Water from the laundry Water from showers and washrooms	Low level of activity concentration, water contains detergents
Regenerated and flushed water from the steam generator blowdown system	Low level of activity concentration, only in case of a steam generator leakage

Table 3-1: Typical waste waters in a nuclear power plant with a pressurized water reactor

Waste Waters	Water Characteristics
Sump water from power plant compartments Laboratory and decontamination water Water from the condensate polishing system Decanted water from concentrate treatment	Higher level of activity concentration
Water from the laundry Water from showers and washrooms	Low level of activity concentration, water contains detergents

Table 3-2: Typical sources of water in a nuclear power plant with a boiling water reactor

(4) The number and storage capacity of collection and discharge tanks shall fulfill the requirements of specified normal operation. **Table 3-4** lists corresponding orientation values for the case of nuclear power plants with an electric power greater than 1100 MW.

(5) The number and capacity of the tanks for radioactive concentrates shall be designed in accordance with safety standard KTA 3604.

Treatment Processes	Throughput rate of radioactively contaminated water in a	
	PWR	BWR
Evaporator facility (amount of distillate)	4 m^3/h	4 m^3/h
Ion exchange facility	-	60 m^3/h
Mechanical cleaning facility (centrifuges or filters)	5 m^3/h	5 m^3/h

Table 3-3: Orientation values for the accumulation of radioactively contaminated water to be treated in the case of a nuclear power plant with an electric power greater than 1100 MW

Type of Tanks	Minimum number	Minimum capacity of each tank
Collection tanks	4	70 m^3
Discharge tanks	2	70 m^3

Table 3-4: Orientation values for the collection and discharge tanks in the case of nuclear power plants with an electrical power greater than 1100 MW

(6) The condensate accumulated from outside-air in the air supply system of the nuclear power plant does not have to be fed into the facilities for treating radioactively contaminated water.

3.3 Treatment Processes

3.3.1 General requirements

The choice and design of the treatment processes shall be based on the plant-site-specific requirements regarding the intentional discharge of waste water. Typical treatment processes, aside from those specified in Section 3.2 para. 2, are precipitation, flocculation, sedimentation and, also, biological processes.

Note:

Further requirements regarding the treatment and storage of solid and liquid radioactive wastes that accumulate from the treatment of radioactive water are in accordance with safety standard KTA 3604.

3.3.2 Evaporation

(1) In order to minimize scaling on the evaporator heating tube elements and to remove initial scale deposits at an early stage, the facility shall be equipped for a regular chemical cleaning operation (e.g., after each blow-down).

(2) The design of the evaporator heating surface shall account for a power capacity reserve of about 15%.

(3) The decontamination factor of the evaporator facility shall be at least 10^6 under the conditions as specified under Section 6.3.4 para. 4.

3.3.3 Centrifugation or filtration

Centrifuges or mechanical filters shall be employed for the further treatment of mechanically polluted or biologically treated water.

3.3.4 Ion exchange

Water with a low ionic concentration and an increased activity concentration may be treated in a mixed-bed filter.

3.3.5 Precipitation and flocculation

Precipitation and flocculation of radioactively contaminated water shall normally only be employed in conjunction with a further treatment process specified under Section 3.3.2 or Section 3.3.3.

3.3.6 Sedimentation

Water containing precipitable solids may be treated by sedimentation.

3.3.7 Biological processes

Biological processes for treating radioactively contaminated water shall normally only be employed in conjunction with a further treatment process as specified under Section 3.3.2 or Section 3.3.3.

4 Structural Design

4.1 General Requirements

(1) The facilities for treating radioactively contaminated water shall be designed for reliable, continuous operation, and such that they need as little maintenance as possible and are easy to decontaminate.

(2) When designing and arranging the facilities and their components, the requirements specified in Sec. 4 of safety standard KTA 3604 for the handling and storing of radioactive concentrates shall be taken into account.

(3) The requirements in accordance with Sec. III BetrSichV shall be met as a minimum.

(4) It must be ensured that radioactively contaminated water from leakage, overflow, or incorrect operation of the facilities or their components cannot seep into the soil, into the surface or ground water or into a drainage system intended for non-radioactive waste water.

(5) To prevent radioactive substances from dissipating into the room atmosphere, the facilities' components shall be vented directly into the exhaust air of the system (cf. Sec. 5.3.2 para. 3 KTA 3601). Any other possible venting of radioactivity-containing components into the room atmosphere (e.g., from overflow lines) shall be prevented by appropriate means.

(6) A seepage or dissipation of radioactivity into connected no-radioactivity-containing systems (e.g., demineralized water system, flushing water system, sealing water system) shall be prevented by installing suitable valves, by an appropriate arrangement of the pipe connections or by a check-valve coupling in the case of hose connections.

(7) A seepage or dissipation of radioactivity into no-radioactivity-containing systems that lead out of a controlled area shall be prevented by taking Sec. 3.8 para. 2 of safety standard KTA 1504 into account.

(8) No-radioactivity-containing systems with heat exchangers (e.g. auxiliary steam and cooling water systems) shall be equipped with suitable devices (e.g. sampling points or activity measuring instruments) to identify radioactivity leakages.

(9) The materials used – also for linings, membranes and seals – shall withstand the operational load conditions (e.g., from mechanical, thermal or chemical loadings as well as from

ionizing radiation). In the case of age-sensitive materials, the temporal behavior shall be taken into account.

(10) The components of the facilities shall be classified in accordance with their radioactive inventory (e.g., Konvoi-Specifications K3, K4a, K5).

4.2 Structural Arrangement

(1) The facilities for treating radioactively contaminated water shall be installed inside a controlled area.

(2) The concentrate tanks shall stand within watertight vats. In case the vat cannot take up the entire volume of the respective tank, a leakage monitoring system shall be installed.

(3) The components of the facilities shall be arranged in the building such that long pipe lines and long access routes for their operation are avoided.

(4) The collection, discharge and concentrate tanks shall, preferably, be located at the lowest points of the facility or of the building. The components shall normally be installed above the tanks such that the treated water and the residues can freely run into the corresponding tanks by gravitational flow.

(5) Building sumps and collecting reservoirs shall be located at the lowest points of the buildings or in building units particularly designed for this purpose. Sumps and reservoirs shall be constructed of materials resistant to corrosion or shall be appropriately protected (e.g. rubber lining, plastic coating).

(6) If room drains are not provided, the room shall be designed in form of a watertight vat with a capacity to accommodate the contents of the largest tank installed in the room. It shall be possible to pump any radioactively contaminated water released into this vat into intact tanks without any danger to the operating personnel. Measuring instruments (e.g. moisture monitoring sensors, aerosol monitors, level indicators) shall be installed to display and signal any leakages.

(7) Emptying a discharge tank shall only be possible by a single pump. Any gravitational flow from a discharge tank through the drain pipe shall be prevented by a suitable pipe routing (e.g. pipe loop). This pipe routing shall be based on highest possible filling level of the tank.

(8) The overflow pipes of the discharge tanks may not be connected to each other in any way that would allow the overflow of one tank to overflow into the other tank.

(9) Deviating from paragraph 8, the overflows of the other types of tank groups shall be arranged such that first the neighboring tanks are filled before they can jointly overflow.

(10) The evaporator facility shall be designed and arranged such that, taking radiation protection into account, the cleaning of the evaporator heating tube elements is possible in the installed state. It should be possible that the waste water accumulating during the cleaning process can be discharged directly into the collection tanks.

(11) The chemical dosing station shall be located in a chemically resistant sealed vat.

Note:

In addition, the industrial safety regulations prescribed for the handling of chemicals shall be observed.

4.3 Components

4.3.1 Tanks and heat exchangers

(1) The operation of the facilities for treating radioactively contaminated water shall not lead to any impermissible operational pressures.

(2) The materials for the evaporator facility shall be resistant to any of the corrosive influences to be assumed.

Note:

Suitable materials are, e.g., 1.4539 and 2.4858.

(3) Tanks installed in vats shall be anchored down to prevent possible buoyant floating.

(4) The tank inlets shall be designed and constructed such that any damage to the inner surfaces by gravitational flow erosion is prevented.

(5) Collection tanks used for sedimentation purposes shall be equipped with a conical base.

(6) Tanks shall basically be provided with non-isolatable overflows and non-isolatable venting nozzles. If these are constructed to be isolatable, then other safety devices (e.g. safety valves, overflow valves, vacuum breakers) shall be provided. If the overflow pipes open into the room, a release of the dead air in the pipe to the room atmosphere shall be prevented (e.g. by a surge chamber).

(7) Equipment shall be installed inside the tanks which permits an effective mixing of the contents of the tank. Thorough mixing shall preferably be achieved by stirring or by recirculated pumping. During the mixing, ingress of water into the system exhaust air shall be prevented.

(8) The possibility for a decontamination (e.g., by flushing) shall be provided for all tanks and heat exchangers where radioactive deposits cannot be excluded.

4.3.2 Pumps, valves and mixers

(1) The vessel penetrations of the pump and mixer shafts shall basically be located above the maximum filling level. If a penetration is necessary below the maximum filling level, any release of radioactively contaminated water shall be prevented (e.g. by a water-barrier slip-ring seal).

(2) In designing concentrate transfer pumps, the danger of blockage shall be taken into consideration.

(3) The design and construction of the valves shall be purpose-oriented. In the case of water with an increased content of solid matter, free-flow valves (e.g. ball cocks or stop cocks) shall be chosen. If membrane valves are installed, they shall not be used for control purposes. Dead-flow zones shall normally be prevented.

4.3.3 Pipe lines

(1) The wall thickness of steel pipes and pipe elbows under internal pressure shall be calculated in accordance with DIN EN 13 480-3.

Note:

Additional analytical principles are specified in the Series B of the AD-2000 Merkblätter.

(2) Pipe lines shall be routed such that a correct filling, venting and draining is possible.

(3) Pipe lines carrying waste water shall be routed with a gradient of at least 1 %, and pipe lines carrying concentrates with a gradient of at least 2.5 %.

(4) In the case of pipe lines carrying concentrates or resins and in the case of pipe lines carrying auxiliary materials for filters, the pipe elbows or bends used shall be as large as possible (e.g. with a radius of curvature larger than or equal to three times the pipe diameter).

(5) Pipe lines carrying solids shall be routed and arranged such that, as far as possible, no dead flow zones exist and no

build-up of deposits will be possible. In addition, possibilities for flushing these pipes shall be provided for.

(6) Pipe lines below the maximum possible water level as well as pressurized pipe lines shall meet the requirements for the respective component for the whole distance from this component out to the first shut-off valve.

4.4 Monitoring and Surveillance of the Facility

(1) All important system parameters (e.g. filling level, temperature, pressure, mass and volumetric flow rate, pH value, conductivity) shall be measured and shall be transmitted to the control station for the facilities of treating radioactively contaminated water, such that the condition of the system can be quickly and reliably identified.

Note:

Requirements for the design of the control station are specified in safety standard KTA 3904.

(2) Measuring equipment shall be installed which, immediately upon operating conditions being exceeded, will initiate automatic measures for the protection of the component and connected systems. The measuring equipment shall withstand the operational load conditions (e.g., from mechanical, thermal or chemical loadings as well as from ionizing radiation).

(3) Only those alarms that signal an equipment malfunction need to be displayed in the main control room of the nuclear power plant, and this only as group alarms. It shall be only possible to acknowledge the malfunction and warning alarms from the control station of the facilities for treating radioactively contaminated water.

(4) The facilities shall be equipped with sampling points.

(5) Any routinely recurring functional sequence should be automated in view of reducing the work load of the operating personnel.

(6) The inlet and the outlet of the discharge tanks shall be equipped with a mutual interlock system. From the beginning of the re-circulation before sampling until the end of the discharge pumping procedure, the inlet shall be locked such that it cannot be opened in this time period.

(7) In view of a possible scale build-up on the heating tube elements, the evaporator facility shall, additionally, be equipped with a pressure measuring device on the heating steam side and a flow measuring device in the distillate pipe. These measuring devices shall be monitored during operation.

Note:

A decreasing evaporator capacity and an increasing heating steam pressure can be indications for scale build-up on the heating tube elements.

5 Operation and Maintenance

(1) The operation and maintenance of the facilities for treating radioactively contaminated water shall be detailed in the operating manual in accordance with safety standard KTA 1201.

(2) Detailed records shall be kept with regard to the water balance within the facilities.

6 Tests and Inspections of the Facilities for Treating Radioactively Contaminated Water

6.1 General Requirements

(1) The facilities shall be subjected to tests and inspections.

(2) The tests and inspections shall include:

a) Appraisal prior to construction,

b) In-process inspections (during fabrication),

c) In-service inspections.

(3) The results with regard to paragraph 2 item a) shall be documented in expert analyses or respective statements, the results with regard to paragraph 2 item b) in documents in accordance with Documentation Class C BMI-Circular, and the results with regard to paragraph 2 item c) in the way to be specified in the testing manual in accordance with safety standard KTA 1202.

6.2 Appraisal Prior to Construction

(1) The design of the facilities shall be appraised with the objective of verifying whether safe operation of the facilities is ensured for all operating conditions. Special attention shall also be paid to the testability and to easy maintenance of the facilities and their components.

(2) The following documents shall constitute the basis for the appraisal:

a) safety analysis report,

b) description of the facilities or systems,

c) technical drawings of the facilities or systems,

d) activity flow diagram (volumetric flow rates and activity concentrations),

e) list of measuring points and the interlock list for safety-related functions,

f) specification regarding materials and construction tests,

g) installation plans (arrangement of the components) or true-to-scale models.

(3) The documents shall be reviewed to verify whether or not

a) all safety-related parts of the facilities have been identified and are adequately described,

b) the design of the facilities and their components meet the requirements of this safety standard,

c) the classification of the components of the facilities is in accordance with their safety relevance,

d) the specifications regarding materials and construction tests meet the requirements specified under Section 6.3.3.

6.3 In-Process Surveillance During Construction

6.3.1 General Requirements

(1) The in-process surveillance of the facilities together with the documentation shall include:

a) design reviews,

b) materials, assembly and pressure tests,

c) acceptance and functional tests.

(2) The components shall be tested by authorized experts appointed by the proper authority to verify that they meet the requirements. The extent of the tests is specified by the proper authority under consideration of the classification of the respective component.

6.3.2 Design review

The following documents relating to the facilities shall be submitted for the design review:

a) design data sheets,

b) schematic drawings and selected detail drawings,

c) isometric drawings for pipe lines larger than DN 50 (in general, for an accompanying design review during erection, however, before the pressure test),

d) parts lists including materials data,

e) strength calculations (dimensioning analyses; analysis of the dynamic behavior, if required),
f) construction examination sequence plans,
g) welding schedules (including data regarding heat treatment, if required).

6.3.3 Materials, construction and pressure tests

(1) The component parts and components of the facilities shall be subjected to tests in the manufacturing plant, and their assembly to tests in the nuclear power plant to verify their compliance with the design reviewed documents. Depending on the requirements, the test shall be finished up by a pressure test or by a leak test.

(2) The required tests and the type of test certificates shall be specified in the course of the appraisal of the facilities prior to their erection (cf. Section 6.2) and in the course of the design review (cf. Section 6.3.2).

(3) Nondestructive tests on pressure vessels shall be carried out in accordance with the requirements of AD-2000 Merkblatt HP 5/3.

(4) On completion of the facilities in the manufacturing plant or at the building site, all documents required in accordance with the BMI Circular and with ZPI shall be available and updated with respect to the realized construction.

(5) The final inspection shall be performed in the form of a system oriented pressure or leak test in the presence of the proper authority or of an authorized expert appointed by the proper authority, or, if applicable, of the facility manufacturer (cf. Section 6.3.1), .

(6) The pressure test shall normally be carried out as a hydrostatic test at 1.43 times the design pressure.

(7) The leak test on the section to be tested shall, generally, be performed as a pressure test with air at an over-pressure of 1 bar. After depressurizing to an over-pressure of 0.2 to 0.5 bar, all detachable connections shall be subjected to a leak test using foaming liquids.

(8) Tanks of an open design (e.g. chemicals tanks and precoat tanks) shall be subjected to a water level test.

6.3.4 Acceptance tests and functional tests

(1) Prior to commissioning, the facilities and their components shall be subjected to an acceptance test and functional test.

(2) Before performing the acceptance tests and functional tests, the final inspections shall be completed and the results of the materials, construction, and pressure tests shall be available (documentation). For the acceptance tests and functional tests, all of the respective test results shall be presented to the proper authority or to an authorized expert appointed by the proper authority or, if applicable, to the facility manufacturer (cf. Section 6.3.1).

(3) The documents required in accordance with No. K of ZPI shall be presented for the acceptance tests and functional tests. On the basis of these documents, the correspondence between the licensed and actually built facilities shall be verified.

(4) It shall be demonstrated that the decontamination factor of the evaporator facility specified under Section 3.3.2 para. 3 can be attained. This demonstration shall basically be carried out within the framework of the commissioning tests by a test with the non-radioactive substance, magnesium sulfate ($MgSO_4$); alternatively, a test at another evaporator facility shall be referenced, the essential component parts of which must be of the identical design. The decontamination factor shall be determined at a point in time when the evaporator facility is in a state of equilibrium with the salt mass fraction in the evaporator cavity in the range from 0.15 to 0.20, and is operated at the design level rate of through-flow and return-flow. At the beginning of the tests, the salt mass fraction in the evaporator cavity shall be in the range from 0.05 to 0.1.

Note:

The salt contents in the test with the non-radioactive substance may be determined, e.g., from measuring the atomic absorption. If a decontamination factor of 10^6 is attained with $MgSO_4$ under the conditions mentioned above, it can be expected that the decontamination factor for non-volatile radioactive substances will be at least 10^5.

(5) The perfect safety-related functioning of the facilities, and their security against the pressure and temperature exceeding limit values, shall be verified and certified by the authorized experts appointed by the proper authority. The extent of the tests is specified by the proper authority.

(6) All tanks and vessels subject to BetrSichV or to AtG shall be subjected to an acceptance test at their location of installation; this test shall be certified.

6.4 Inservice Inspections

6.4.1 Purpose and extent of the inservice inspections

(1) It shall be demonstrated by inservice inspections that the safety equipment and protective measures of the facilities continue to meet the specified requirements and that, in comparison to the acceptance tests, their safety-related functioning has not been impaired.

(2) The inspections shall include:

a) inspection of the operational records regarding maintenance tasks including the documentation of these tasks,
b) walk-through inspection of the facilities and verification of the correct functioning of the facilities and their components, especially of safety equipment and protective measures required as specified in this safety standard or in licensing provisions.

(3) The type and extent of the tests and inspections shall be individually specified in testing schedules and testing instructions as part of the testing manual in accordance with KTA 1202. It shall be specified in this context, which components and functions are to be subjected to regular inservice inspections and in what testing intervals.

6.4.2 Documentation

The documentation of the tests shall be carried out in accordance with the requirements specified in safety standard KTA 1404.

Appendix A

Regulations Referred to Within this Safety Standard

Regulations referred to in this safety standard are valid only in the version 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 2, Sec. 2. of the Act of July 20, 2017 (BGBl. I, p. 2808)
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 in accordance with Article 10 changed by Article 6 of the Act of Janu-ary 27, 2017 (BGBl. I, p. 114, 1222)
SiAnf	(2015-03)	Safety Requirements for Nuclear Power Plants (SiAnf) of 22 November 2012 (BAnz AT 24.01.2013 B3), revised version of 3 March 2015 (BAnz AT 30.03.2015 B2).
Interpretations	(2015-03)	Interpretations of the "Safety Requirements for Nuclear Power Plants of 22 November 2012” (BAnz AT 24.01.2013 B3), revised version of 3 March 2015 (BAnz AT 30.03.2015 B2)
BetrSichV		Ordinance on industrial safety (Betriebssicherheitsverordnung – BetrSichV) of February 3, 2015 (BGBl. I, p. 49), most recently changed by Article 147 of the Act of March 29, 2017 (BGBl. I, p. 626)
Circular of BMI	(1982-08)	Requirements for the documentation for nuclear power plants, Circular of BMI of 5.8.1982 - RS I 6 - 513 127/11
ZPI	(1982-10)	Compilation of the Information Required for Review Purposes under Licens-ing and Supervisory Procedures for Nuclear Power Plants (ZPI) of October 20, 1982 (BAnz. No. 6a/1983 of January 11, 1983)
KTA 1201	(2015-11)	Requirements for the operating handbook
KTA 1202	(2009-11)	Requirements for the testing manual
KTA 1301.1	(2017-11)	Radiation protection considerations for plant personnel in the design and op-eration of nuclear power plants; Part 1: Design
KTA 1301.2	(2014-11)	Radiation protection considerations for plant personnel in the design and op-eration of nuclear power plants; Part 2: Operation
KTA 1404	(2013-11)	Documentation during the Construction and Operation of Nuclear Power Plants
KTA 1504	(2015-11)	Monitoring and assessing of the discharge of radioactive substances in liquid effluents
KTA 3601	(2017-11)	Ventilation systems in nuclear power plants
KTA 3604	(2005-11)	Storage, handling, and plant-internal transport of radioactive substances in nuclear power plants (with the exception of fuel assemblies)
KTA 3904	(2017-11)	Control Room, Remote Shutdown Station and Local Control Stations in Nu-clear Power Plants
AD-2000 Merkblatt	(2015-04)	Fabrication and testing of connections; Non-destructive testing of weld con-nections
DIN EN 13480-3	(2014-12)	Metallic industrial piping - Part 3: Design and calculation
DIN 25476	(2012-11)	Primary-coolant clean-up system in nuclear power plants with light water re-actors