

Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 3401.4 (2022-11)

**Steel Containment Vessels
Part 4: In-service Inspections**

(Reaktorsicherheitsbehälter aus Stahl;
Teil 4: Wiederkehrende Prüfungen)

Previous versions of this Safety Standard
were issued 1981-03, 1991-06 and 2017-11

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

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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, the 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 task of specifying those safety-related requirements which shall be met with regard to precautions to be taken in accordance with the state of science and technology against damage arising from the construction and operation of the plant (Sec. 7, para. (2), subpara. (3) Atomic Energy Act - AtG) in order to attain the protective goals specified in the AtG, the Radiation Protection Act (StrlSchG) and the Radiation Protection Ordinance (StrlSchV) as well as further detailed in the Safety Requirements for Nuclear Power Plants (SiAnf) and the Interpretations of the SiAnf.

(2) Basic requirements for the reactor containment are contained in the Safety Requirements for Nuclear Power Plants in Requirement No. 3.6, "Requirements for the Safety Enclosure" as well as in Sec. 6 "Containment" of Interpretation I-2 "Requirements for the design of the reactor coolant pressure boundary, the external systems as well as the containment".

The requirements of the Safety Criteria cited above are concretized with respect to steel containment vessels by the following safety standards

- KTA 3401.1 Materials and Product Forms
- KTA 3401.2 Design and analysis
- KTA 3401.3 Manufacture
- KTA 3401.4 In-service inspections
- KTA 3405 Leakage Test of the Reactor Containment Vessel
- KTA 3413 Determination of Loads for the Design of a Full Pressure Containment Vessel against Plant-Internal Incidents

and, with respect to penetrations and airlocks, by the following safety standards

- KTA 3402 Airlocks on the Reactor Containment of Nuclear Power Plants - Personnel Airlocks
- KTA 3403 Cable Penetrations through the Reactor Containment Vessel
- KTA 3407 Pipe Penetrations through the Reactor Containment Vessel
- KTA 3409 Airlocks on the Reactor Containment of Nuclear Power Plants - Equipment airlocks.

Furthermore, Safety Standard KTA 3404 applies to the isolation of operation-system related pipes penetrating the reactor containment vessel in the case of a release of radioactive materials into the reactor containment vessel.

(3) The task of the steel containment vessel is to resist the pressure and temperature loads which can occur during plant accidents connected with the release of radioactive materials inside the containment, in particular in conjunction with the leakage cross-sections of the primary coolant system to be assumed; thus, no unallowed release of radioactive materials to the environment becomes possible. For this reason, the containment and all penetrations are designed such that, under consideration of the allowed leakage rate, they resist the dynamic, static and thermal loads occurring in conjunction with the above mentioned accidents and the consequential failures. During normal operation, the containment, furthermore, has the task of conducting the air flow.

(4) The containment is designed e.g. as a technically airtight steel vessel into which the pipe and cable penetrations as well as personnel and equipment airlocks are inserted.

(5) In order to enable the containment to comply with the above mentioned task, it is necessary to set up standards for technical and organizational measures, e.g.,

- a) choice and use of materials of high fracture toughness and good workability,

- b) design and construction in consideration of a well-suited stress flow,
- c) choice of fabrication and testing procedures and documentation of testing steps and results,
- d) unambiguous instructions regarding the activities during manufacture and processing of the materials.

These measures are dealt with in the Safety Standards KTA 3401.1, KTA 3401.2 and KTA 3401.3.

(6) The present Part 4 of the KTA 3401 series deals with the in-service inspections of the containment vessel, airlocks (KTA 3402 and KTA 3409), erection and transportation openings, pipe and cable penetrations (KTA 3407 and KTA 3403), as well as of the isolating devices for the operating system pipes penetrating the containment vessel (KTA 3404). The Safety Standard KTA 3401.4 is correlated with the requirements of KTA 3401.1, KTA 3401.2 and KTA 3401.3 and applies in connection with these Safety Standards.

(7) The object of this Safety Standard is to specify the extent and time intervals for the regular in-service tests and inspections of the above mentioned components performed with the aim to repeatedly demonstrate their integrity and functionality.

1 Scope

(1) This Safety Standard applies to the in-service inspections of steel containment vessels of light water reactors, including integrally connected to the containment vessel components of airlocks, erection and transportation openings, pipe and cable penetrations, as well as of the isolating devices for the operating system pipes penetrating the containment vessel.

(2) This Safety Standard also applies to containment vessels equipped with a pressure suppression system and an external liner.

(3) This Safety Standard applies to all regular in-service inspections subsequent to first criticality including the first recurrent integral leakage rate test (pre-operation leakage rate test)

2 Definitions

- (1) Representative locations, components or component parts

Such locations, components or component parts are considered to be representative where the in-service inspection will lead to sufficiently comparable safety related results for other locations, components or component parts, taking into consideration the material composition, design and manufacturing quality as well as the stress type, level and frequency.

- (2) Authorized inspector

The authorized inspector for the tests and inspections to be conducted in accordance with this Safety Standard is the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act. The inspections/reviews required by this Safety Standard shall be performed on the basis of applications made by the competent authority.

3 In-service Inspection

3.1 General

(1) All tests and inspections on the reactor containment vessel and its components listed in Section 1 shall be documented in a test and inspection schedule; this schedule, together with the corresponding test instructions shall become part of the testing manual of the plant.

(2) The requirements for the testing manual including contents, structure, layout and creation of the testing schedule and test instructions are specified in KTA 1202.

(3) The nuclear power plant licensee shall take the necessary steps to ensure that the tests and examinations listed in the testing manual are performed at the dates fixed.

(4) The type and extent of the tests, the test procedures to be used and the applicable inspection intervals are specified in subsection 3.3 for each component.

(5) If anything unusual is noticed in the course of inspection of the general condition, then additional tests and inspections, e.g. visual testing, shall be performed in the respective testing areas.

3.2 Requirements regarding test procedures

3.2.1 Evaluation of the general condition

(1) The evaluation of the general condition shall be performed by inspection, possibly with aid of auxiliary optical devices (if the distance between test object and eye needs to be shortened or an otherwise hidden test object has to be made visible to the eye).

(2) During the evaluation of the general condition the following shall especially be taken into consideration:

- a) mechanical damage (e.g. points of friction, deformations),
- b) condition of the safety locks of bolts,
- c) condition of the connections of measurement points and conductors,
- d) indications of leakage,
- e) clearance for the displacements to be considered,
- f) moisture penetrations into the soft-material intermediate layers or insulation.

3.2.2 Visual testing

(1) When performing visual testing the requirements of DIN EN 13018 shall be met.

(2) Depending on the task, visual testing shall be either made as integral visual testing or as selective testing, in which case

- a) integral visual testing is performed to evaluate the general condition of components
- b) selective visual testing is performed as local visual examination for the unambiguous detection of specific characteristics

of the examined region.

(3) During visual testing, special attention shall be paid to:

- a) surface changes (e.g., corrosion scars, crack initiation),
- b) mechanical damage (e.g., friction points, deformations).

3.2.3 Leakage test

The leakage test of the airlocks, erection and transportation openings as well as of the isolation devices and compartments of pipe penetrations shall be performed, e.g.,

- a) by increasing the pressure and applying foaming materials to the sealing surfaces, or
- b) with the aid of the leakage exhaust system, or
- c) by determining the rate of pressure increase or decrease.

3.2.4 Functional tests

(1) It shall be determined by means of regular functional tests on airlocks, isolation devices and containment vessel with pressure suppression systems whether the examined components or the examined system are functionally fit.

(2) Test instructions shall be established which lay down the performance of the test, the function-relevant parameters and criteria to be observed for the plant and construction-specific evaluation of the test to be performed.

3.3 Component-specific tests and inspections

3.3.1 Tests and inspections of the reactor containment vessel

3.3.1.1 Evaluation of the general condition

(1) The wall of the containment vessel, the nozzle regions of airlocks and pipe penetrations, the region of erection openings, the seals of the clamping area as well as the weld seams of the mountings on the pressure retaining wall of the containment vessel shall be inspected. The inspections shall be extended, basically, to all regions visually accessible without disassembly.

(2) The licensee shall perform the inspections in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act at annual intervals in partial quantities on representative locations. The entire accessible surface shall be covered within a period of four years.

(3) The regions of thermal insulation shall be randomly inspected within a period of four years with special attention being paid to corrosive damage or to changes in insulation effectiveness by ingress of moisture.

3.3.1.2 Leakage test

The leakage test of the containment vessel shall be performed by an integral leakage rate test in accordance with Sec. 3.5.

3.3.1.3 Non-destructive testing of weld seams

The non-destructive testing of weld seams of the containment vessel shall be performed in accordance with the criteria specified in Sec. 3.3.8.

3.3.2 Tests and inspections of airlocks

3.3.2.1 Evaluation of the general condition

(1) The gate seals, hydraulic or pneumatic drives, electrical devices, pressure retaining walls, moveable rail sections and the airlock supports shall be inspected. The inspection shall be extended to all regions visually accessible without disassembly (normal extent). In the case of enlarged inspection extent, removable coverings shall be removed.

(2) The inspections shall be carried out by the licensee at monthly intervals (normal extent) and at annual intervals by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act (enlarged inspection extent). For containment vessels with an inert gas atmosphere, differing inspection intervals may be specified in well founded cases.

3.3.2.2 Functional tests

(1) Functional tests shall be conducted on drives, controls, protective devices, and the alarm, telephone, signalling and lighting devices.

(2) Functional tests shall be carried out by activating operational functions including the priority controls of the airlock gates (cf KTA 3402 and KTA 3409).

(3) The functional tests on personnel airlocks shall be performed by the licensee at monthly intervals and those on equipment airlocks at semiannual intervals; once a year, these tests shall be performed in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance

with Section 20 of the Atomic Energy Act. For containment vessels with an inert gas atmosphere, differing examination intervals may be specified in well founded cases.

3.3.2.3 Leakage tests

(1) Leakage tests shall be conducted on the gate seals, pressure compensation equipment and penetrations for mechanical drive elements as well as on the seals of removable connecting elements of, e.g., manhole covers, blind covers, sight glasses, pipe and cable penetrations. Sec. 3 3.5 applies to cable penetrations.

(2) The leakage tests on gate seals, pressure compensation equipment and penetrations for mechanical drives shall be performed at annual intervals by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act.

(3) The leakage tests on the seals of removable connections of, e.g., manhole covers, blind covers, sight glasses and pipe penetrations shall be performed at four-year intervals by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act.

3.3.2.4 Non-destructive testing of weld seams

The non-destructive testing on weld seams of the airlocks shall be conducted in accordance with the criteria specified in Sec. 3.3.8.

3.3.2.5 Tests of the airlock hydraulics

(1) The tripping pressures of pressure limiting valves and other spring-actuated valves in the airlock hydraulics, the faulty- or non-opening of which may affect the leak tightness of the airlock, shall be tested and the results documented.

(2) The adequate tightness of back pressure valves and isolating valves in the airlock hydraulics, the leakage of which may affect the tightness of the airlock, shall be tested and the results shall be documented.

(3) The tests of the airlock hydraulics shall be performed every four years before the test of the integral leakage rate of the reactor containment in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act.

3.3.3 Tests and inspections of erection and transportation openings

3.3.3.1 Evaluation of the general condition

(1) The inspection shall be carried out on the erection and transportation openings as well as the closure covers connected to the containment vessel by pressure-retaining bolt connections. The inspection shall extend to all regions accessible without disassembly or auxiliary devices.

(2) The inspection shall be conducted by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act at four-year intervals.

(3) The re-installation of the covers of erection and transportation openings and of the closure covers connected to the containment vessel by pressure-retaining bolt connections shall be performed in accordance with design-reviewed instructions.

3.3.3.2 Visual testing

Every time before reseating an erection or transportation opening, its sealing surfaces shall be subjected to a selective visual testing by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act.

3.3.3.3 Leakage tests

(1) Leakage tests shall be conducted on the seals of the erection and transportation openings as well as of the closure covers connected to the containment vessel by pressure-retaining bolt connections.

(2) The leakage tests shall be conducted by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act following every re-installation of the individual cover.

3.3.3.4 Non-destructive testing of weld seams

The non-destructive testing of the weld seams of erection and transportation openings and of closure covers connected to the containment vessel by pressure-retaining bolt connections shall be conducted in accordance with the criteria specified in Sec. 3.3.8.

3.3.4 Tests and inspections of isolation devices

3.3.4.1 General

When specifying the in-service testing of isolation devices in pipes penetrating the containment vessel, distinction shall be made between isolation devices within

- a) pipes transporting reactor coolant,
- b) pipes that open to the containment vessel atmosphere and serve as air inlet and air exhaust in the phase of power operation,

Note:

Pipes are considered to be open to the containment vessel atmosphere if they directly connect the atmosphere inside with that outside of the containment vessel.

- c) pipes that open to the containment vessel atmosphere and serve as air inlet and air exhaust in the phase of reduced pressure of the primary circuit,
- d) pipes with a nominal diameter less than DN 50 that open to the containment vessel atmosphere and serve for the operational surveillance,
- e) pipes that neither transport reactor coolant nor open to the containment vessel atmosphere,
- f) pipes with a nominal diameter equal to or less than DN 80 that serve in the inertisation of boiling water reactors, where the isolation device is basically closed and open only during the inertisation process,
- g) pipes with a nominal diameter exceeding DN 80 and less than DN 250 that serve in the inertisation of boiling water reactors, where the isolation device is basically closed and open only during the inertisation process,
- h) pipes with a nominal diameter exceeding DN 80 that serve in the inertisation of boiling water reactors, where the isolation device is closed in the phase of power operation and open only in the phase of reduced pressure of the primary circuit.

3.3.4.2 Evaluation of the general condition

(1) Systems supplying the isolation devices with auxiliary media and electrical power shall be inspected with special regard

to their proper connections and freedom from any external damage.

(2) Ventilation valves shall be inspected from the outside, and from the inside only as far as possible without disassembly.

(3) The inspection intervals and institutions responsible for performing the examinations are specified in **Table 4-1**. For containment vessels with an inert gas atmosphere, differing examination intervals may be specified in well founded cases.

3.3.4.3 Functional tests

(1) The functionality of each isolation device under Sec. 3.3.4.1 shall be tested by proper operational initiation, unless this test was already performed when testing the reactor protection system. Additionally, the achievement of the required actuating time shall be demonstrated.

(2) If the closed position of an isolation device is secured by an interlock, the functional test shall be extended to also testing this interlock.

(3) The test intervals and institutions responsible for performing the tests are specified in **Table 4-1**. For containment vessels with an inert gas atmosphere, differing test intervals may be specified in well founded cases.

3.3.4.4 Leakage tests

(1) The isolation devices in accordance with Sec. 3.3.4.1, items b), c), g) and h) shall be subjected to leakage tests. The tests shall extend to the leak tightness of the isolation device and of moveable penetrations through the valve casing.

(2) If the design of the isolation devices in accordance with Sec. 3.3.4.1, items g) and h) does not allow for a component specific leakage test, e. g., in the case of double gasket seals, then the leakage test of the valves shall be performed using the test connection between the two isolation devices.

(3) The test intervals and institutions responsible for performing the test are specified in **Table 4-1**.

3.3.5 Tests and inspections of cable penetrations

3.3.5.1 Evaluation of the general condition

(1) The inspection shall be carried out on cable penetrations and the blind flanges of reserve openings.

(2) The inspection shall be conducted by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act at annual intervals on random lots of representative cable penetrations. The random lot shall be chosen such that, within a period of four years, each cable penetration will be covered.

3.3.5.2 Functional tests

Insofar as the functionality of the cable penetrations is not monitored during operation of the corresponding electrical device, their proper function shall be ascertained in the in-service inspections specified for the particular electrical device.

3.3.5.3 Leakage tests

Using appropriate procedures (bubble test, helium leakage test), the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act shall annually subject three randomly selected cable penetrations to leakage tests, testing the leak tightness between cable penetration flange and

containment vessel wall and of the weld seams of the cable penetrations. The overall leak tightness of the cable penetrations shall be demonstrated in connection with the test of the containment vessel in accordance with Sec. 3.5. The test intervals and institutions responsible for performing the tests are specified in **Table 4-1**.

3.3.6 Tests and inspections of pipe penetrations

3.3.6.1 Evaluation of the general condition

(1) All components of the pipe penetrations within the scope of KTA 3407, with the exception of internal regions of chambered pipe penetrations, shall be inspected, especially the expansion joints. In the case of insulated, medium filled pipes, the inspection may be restricted to representative locations of weld seam and pipe regions.

(2) The inspection shall be carried out by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act at annual intervals on random lots of representative pipe penetrations. The random lot shall be chosen such that, within a period of four years, every pipe penetration will be covered. In the case of pipe penetrations of design type IV in accordance with KTA 3407, the inspection of the region between the discharge pipe and the medium filled pipe may be restricted to one pipe penetration at a four-year interval.

(3) In the case of medium filled pipes, the requirements specified in KTA 3201.4 or the corresponding specifications for pressure and activity retaining components of systems outside of the primary circuit shall be taken into consideration.

3.3.6.2 Leakage tests

(1) All pipe penetrations shall be subjected to leakage tests:

- a) The leak tightness of all unchambered pipe penetrations shall be demonstrated in the course of the integral leakage rate test of the containment vessel in accordance with Sec. 3.5.
- b) The leakage tests of the chambers of pipe penetrations with bellows expansion joint on both sides of the containment vessel wall shall be performed by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act in annual intervals.

(2) The test intervals may be changed if the chambers have an internal over-pressure that is continuously monitored.

3.3.7 Additional tests and inspections of containment vessels equipped with pressure suppression system and external liner

3.3.7.1 Evaluation of the general condition

(1) The liner, condensation chamber and its internals, the check valves and burst plates, and the support structure of the internal cylinder shall be subjected to an inspection extending to all internal and external regions visually accessible without disassembly.

(2) The inspections shall be conducted by the licensee at intervals of two years and every four years in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act. On the occasion of the inspections at four-year intervals, the water shall be removed from the condensation chamber. A partial reduction of the water level is permitted, provided, this does not jeopardize the test results.

(3) Depending on the results of the inspection of the condensation chamber, the licensee and authorized inspector may have to conduct additional examinations of the coating in highly

stressed regions at four-year intervals, e.g. by tests for adhesion.

3.3.7.2 Functional tests

(1) All check valves in the roof of the condensation chamber shall be subjected to functional tests. In these tests the opening force of the check valves shall be checked.

(2) A direct force measurement shall be employed in this check (e.g. by using a spring balance).

(3) The functional tests shall be performed at four-year intervals by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act. Additionally, the licensee shall test the check valves subsequent to their actuation.

3.3.7.3 Leakage tests

(1) Leakage tests shall be conducted on the pressure suppression system to check for leakages between the pressure chamber and the condensation chamber. The test shall consist of applying an air current of a constant volumetric rate to the pressure chamber. The elapsed time needed for the differential pressure between pressure and condensation chamber to reach 0.015 MPa shall be measured. Given the net volume of the pressure chamber, the leakage can then be determined from the inflation time and volumetric air current. Equivalent procedures to the one described above may be employed.

(2) The leakage tests shall be performed at two-year intervals by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act. Additionally, the licensee shall conduct a leakage test on the check valves subsequent to their actuations.

3.3.7.4 Non-destructive testing of weld seams

The non-destructive testing of the weld seams in the regions of the pressure suppression system shall be conducted in accordance with the criteria specified in Sec. 3.3.8.

3.3.8 Criteria for the non-destructive testing of weld connections

(1) Those locations of weld connections subjected to operational stresses higher than 25 % of the permissible primary stresses in accordance with Table 6.2-1 KTA 3401.2, loading level 1 (load case - normal operation) shall be subjected to random non-destructive testing at four-year intervals in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20 of the Atomic Energy Act.

(2) The testing shall be conducted, and the test results evaluated, in accordance with KTA 3401.3.

3.4 Leakage rate test by means of the leakage exhaust system

(1) The leak tightness of the components connected to the leakage exhaust system as well as the leak tightness of the system itself shall be quantitatively determined in a joint measurement.

(2) The test shall be performed during stationary operation of the leakage exhaust system by determining the established under pressure and the volumetric flow.

(3) The leakage rate test shall be performed by the licensee in the presence of the authorized inspector called in by the licensing or supervisory authority in accordance with Section 20

of the Atomic Energy Act both at the beginning and at the end of the overhaul period.

3.5 Integral leakage rate test

(1) The integral leakage rate test of the reactor containment vessel including the airlocks, erection and transportation openings, the isolation devices, cable and pipe penetrations shall be carried out using the absolute pressure method.

(2) The test procedure, requirements for the plant condition, the test pressure and test performance as well as the evaluation of the test results shall comply with KTA 3405.

(3) In-service integral leakage rate tests shall be performed during a plant outage (e.g. refuelling outage) after

- a) completion of all maintenance activities affecting the leak tightness and
- b) performance of all required component related leakage tests specified under Sec. 3.3.

(4) The first in-service integral leakage rate test (pre-operational leakage rate test) shall be conducted in the time period between the pressure test of the primary circuit and first criticality.

(5) The intervals for the subsequent in-service integral leakage rate tests are specified in **Table 3-1**. If the permissible leakage rate is only achieved after repair measures have been taken, then the further procedures shall be specified by agreement with the authorized inspector.

Testing interval	Number of years after first criticality
1 year	1 ¹⁾
4 years	5
4 years	9
4 years	13
4 years	etc.
¹⁾ During first scheduled refuelling	

Table 3-1: Testing intervals for the in-service integral leakage rate tests

3.6 Requirements regarding test personnel

(1) The test personnel for inspection of the general condition shall have the expertise and knowledge required to perform their tasks and shall have demonstrated sufficient visual capacity.

(2) The personnel for visual inspections shall meet the requirements to DIN EN 13018 and shall have been qualified and certified to DIN EN ISO 9712.

(3) The personnel performing leakage tests shall provide proof of their expertise and knowledge to perform their tasks. To prove their qualification it is recommended to certify the test personnel in conformance with DIN EN ISO 9712. For the performance of the integral leakage rate test to section 3.5 the requirements of KTA 3405 apply.

(4) The test personnel for functional tests shall have the expertise and knowledge required to perform their tasks.

(5) The following requirements shall apply to the test personnel for non-destructive testing of weld connections according to the criteria specified in Sec. 3.3.8:

- a) The test supervisory personnel shall have been qualified and certified for the testing procedures in the relevant

product or industrial sectors at least with level 2 to DIN EN ISO 9712. For radiographic and ultrasonic testing level 3 qualification and certification is required.

- b) The NDT operators shall have been qualified and certified to DIN EN ISO 9712 for the applicable testing procedures in the relevant product or industrial sectors. For radiographic and ultrasonic testing at least level 2 qualification and certification is required.

4 Collation of testing intervals and responsibilities for performing the tests and inspections

(1) The testing intervals and institutions responsible for performing the in-service tests and inspections in accordance with Sec. 3 are specified in **Table 4-1**.

(2) The testing intervals may deviate from the specified values within the following tolerances:

in case of 1 month	± 8 days
in case of 3 months	± 16 days
in case of 1 year	± 2 months
in case of 2 years	± 4 months
in case of 4 years	± 6 months.

(3) Those tests and inspections that can only be conducted when the reactor is shut down shall be carried out during regular refuelling.

(4) Considering that the time span between two refuellings can be up to 18 months, that refuelling shall be chosen for conducting the test that comes closest to the due date of the particular test. If this leads to longer time intervals than specified, the due dates for the next in-service tests and inspections shall be advanced accordingly such that, in the long run, the averaged time intervals meet the values as specified in the tables. In case a plant shutdown lasts more than six months, special arrangements may be agreed upon.

5 Documentation

(1) The performance and the results of the in-service tests and inspections shall be documented. The test documents shall become part of the plant documentation.

(2) The requirements for the documentation are specified in KTA 1404.

(3) Insofar as abbreviations and symbols are used in the documentation, these shall be chosen in accordance with Sec. 11.3 of KTA 3401.3 and Appendix A of KTA 3405, or they shall be explained in the individual document.

Component	Type of test/inspection	Test interval		KTA Section	Remarks
		Licensee	Authorized inspector		
1 Reactor containment vessel	EGC	(1 y) 4 y	(1 y) 4 y	3.3.1.1	(1 y) = annual partial lot
	Integral leakage rate	4 y	4 y	3.5	in accordance with Table 3-1
	NDT		4 y	3.3.1.3	criteria in accordance with Sec. 3.3.8
2 Personnel airlocks	EGC	1	1 y	3.3.2.1	enlarged inspection extent
	EGC	1 m ¹⁾		3.3.2.1	regular inspection extent
	Functional test	1 m ¹⁾	1 y	3.3.2.2	
	Leakage test	1 y	1 y	3.3.2.3 (2)	
	Leakage test	4 y	4 y	3.3.2.3 (3)	
	NDT		4 y	3.3.2.4	criteria in accordance with Sec. 3.3.8
3 Equipment airlocks	EGC	1 y	1 y	3.3.2.1	enlarged inspection extent
	EGC	1 m		3.3.2.1	regular inspection extent
	Functional test	6 m	1 y	3.3.2.2	
	Leakage test	1 y	1 y	3.3.2.3 (2)	
	Leakage test	4 y	4 y	3.3.2.3 (3)	
	NDT		4 y	3.3.2.4	criteria in accordance with Sec. 3.3.8
4 Erection and transportation openings	EGC	4 y	4 y	3.3.3.1	covers during installation (status check)
	Selective visual testing	before installation	before installation	3.3.3.2	sealing surfaces
	Leakage test	after installation	after installation	3.3.3.3	
	NDT		4 y	3.3.3.4	criteria in accordance with Sec. 3.3.8
5 Isolation devices acc. to 3.3.4.1 a)	EGC	RF	RF	3.3.4.2	
	Functional test	RF	RF	3.3.4.3	
Isolation devices acc. to 3.3.4.1 b)	Test of actuating time	RF	RF	3.3.4.4	
	EGC	3 m ¹⁾	1 y	3.3.4.2	
	Functional test	3 m ¹⁾	1 y	3.3.4.3	
	Test of actuating time	6 m ¹⁾	1 y	3.3.4.3	
Isolation devices acc. to 3.3.4.1 c)	Leakage test	RF	RF	3.3.4.5	
	EGC	prior to RTS		3.3.4.2	
	Functional test	prior to RTS		3.3.4.3	
	Test of actuating time	RF	RF	3.3.4.3	
Isolation devices acc. to 3.3.4.1 d)	Leakage test	RF	RF	3.3.4.4	
	EGC	3 m ¹⁾		3.3.4.2	
	Functional test	3 m ¹⁾		3.3.4.3	
	Test of actuating time	RF	RF	3.3.4.3	
Isolation devices acc. to 3.3.4.1 e)	EGC	RF	RF	3.3.4.2	
	Functional test	RF	RF	3.3.4.3	
	Test of actuating time	2 RF	2 RF	3.3.4.3	
Isolation devices acc. to 3.3.4.1 f)	EGC	3 m ¹⁾		3.3.4.2	
	Functional test	3 m ¹⁾		3.3.4.3	
	Test of actuating time	RF	RF	3.3.4.3	
Isolation devices acc. to 3.3.4.1 g)	EGC	3 m ¹⁾		3.3.4.2	
	Functional test	3 m ¹⁾		3.3.4.3	
	Test of actuating time	RF	RF	3.3.4.3	
	Leakage test	RF	RF	3.3.4.4	
Isolation devices acc. to 3.3.4.1 h)	EGC	prior to RTS		3.3.4.2	
	Functional test	prior to RTS		3.3.4.3	
	Test of actuating time	RF	RF	3.3.4.3	
	Leakage test	RF	RF	3.3.4.4	
6 Cable penetrations	EGC	(1 y) 4 y	(1 y) 4 y	3.3.5.1	(1 y) = annual partial lot
	Leakage test	1 y	1 y	3.3.5.3	random test of 3 penetrations
7 Pipe penetrations	EGC	(1 y) 4 y	(1 y) 4 y	3.3.6.1	(1 y) = annual partial lot
	Leakage test	1 y	1 y	3.3.6.2	chambered pipe penetrations
8 RCV with pressure suppression system (BWR)	EGC	2 y	4 y	3.3.7.1	
	Functional test	4 y	4 y	3.3.7.2	plus subsequent to check valve actuation
	Leakage test	2 y	2 y	3.2.7.3	plus subsequent to check valve actuation
	NDT		4 y	3.2.7.4	criteria in accordance with Sec. 3.3.8
9 Leakage exhaust system	Integral leakage rate test	RF	RF	3.4	at beginning and end of overhaul period

Abbreviations: y : year, m : month, RF : refuelling, RTS : return to service,

EGC : Evaluation of the general condition; NDT : Non-destructive testing

¹⁾ For containment vessels with an inert gas atmosphere, differing test intervals may be specified in well founded cases.

Table 4-1: Testing intervals and institutions responsible for performing the in-service tests and inspections

Annex

Regulations referred to in this Safety Standard

(The references exclusively refer to the version given in this annex. Quotations of regulations referred to therein refer to the version available when the individual reference below was established or issued.)

AtG		Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards (Atomic Energy Act) Atomic Energy Act in the version promulgated on July 15, 1985 (BGBl. I, p. 1565), most recently changed by article 1 of the act dated December 4, 2022 (BGBl. I, p. 2153)
StrlSchG		Act on the Protection against the Harmful Effect of Ionising Radiation (Radiation Protection Act - StrlSchG) Radiation Protection Act of June 27, 2017 (BGBl. I, p. 1966), most recently changed by the promulgation of January 3, 2022 (BGBl. I, p. 15)
StrlSchV		Ordinance on the Protection against the Harmful Effects of Ionising Radiation (Radiation Protection Ordinance - StrlSchV) Radiation Protection Ordinance of November 29, 2018 (BGBl. I, p. 2034, 2036), most recently changed by article 1 of the ordinance dated October, 2021 (BGBl. I p. 4645)
SiAnf	(2015-03)	Safety Requirements for Nuclear Power Plants (SiAnf) of November 22, 2012, amended version of March 3, 2015 (BAnz AT 30.03.2015 B2), most recently changed as promulgated by BMUV on February 25, 2022 (BAnz AT 15.03.2022 B3)
Interpretations of SiAnf	(2015-03)	Interpretations of the safety requirements for nuclear power plants of November 22, 2012, of November 29, 2013 (BAnz AT 10.12.2013 B4), changed on March 3, 2015 (Banz AT of March 30, 2015 B3)
KTA 1202	(2017-11)	Requirements for the testing manual
KTA 1404	(2022-11 Draft)	Documentation during the construction and operation of Nuclear Power Plants
KTA 3201.4	(2016-11)	Components of the reactor coolant pressure boundary of Light Water Reactors; Part 4: Inservice inspections and operational monitoring
KTA 3401.1	(1988-09)	Steel containment vessels; Part 1: Materials
KTA 3401.2	(2016-11)	Steel containment vessels; Part 2: Design and analysis
KTA 3401.3	(1986-11)	Steel reactor safety containment; Part 3: Manufacture
KTA 3402	(2022-11)	Airlocks on the reactor containment of Nuclear Power Plants - Personnel airlocks
KTA 3403	(2022-11)	Cable penetrations through the reactor containment vessel
KTA 3404	(2017-11)	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 3405	(2015-11)	Leakage test of the containment vessel
KTA 3407	(2022-11)	Pipe penetrations through the reactor containment vessel
KTA 3409	(2022-11)	Airlocks on the reactor containment of Nuclear Power Plants - Equipment airlocks
KTA 3413	(2016-11)	Determination of loads for the design of a full pressure containment vessel against plant-internal incidents
DIN EN ISO 9712	(2012-12)	Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712:2012); German version EN ISO 9712:2012
DIN EN 13018	(2016-06)	Non-destructive testing - Visual testing - General principles; German version EN 13018:2016