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of the
Nuclear Safety Standards Commission (KTA)

KTA 3506 (2017-11)

System Testing of the Instrumentation and Control Equipment Important to Safety of Nuclear Power Plants

(Systemprüfung der Sicherheitsleittechnik von Kernkraftwerken)

The previous versions of this safety standard were issued in 1984-11 and 2012-11.

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

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KTA SAFETY STANDARD

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PLEASE NOTE: Only the original German version of this safety standard represents the joint resolution of the 35-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in the Federal Gazette (Bundesanzeiger) of February 5, 2018. Copies of the German version may be mail-ordered through the Wolters Kluwer Deutschland GmbH (info@wolterskluwer.de). Downloads of the English translations are available at the KTA website (http://www.kta-gs.de).

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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) Relevant acts, ordinances and regulation of the federal and state authorities as well as subordinate legal regulations, e.g. the Requirements or the RSK Guidelines, are taken into account in developing the KTA safety standards.

(3) In the present safety standard, it is presumed that conventional requirements and technical standards (e.g., Accident Protection Requirements, DIN-Standards, VDE-Regulations) are adhered to under consideration of the safety-related requirements specific to nuclear power plants.

(4) On the basis of Safety Requirements and their Interpretations, the present safety standard specifies the extent, preparation and execution of the system tests for the instrumentation and control equipment of the safety system of nuclear power plants.

(5) The present safety standard is closely dependent on safety standard KTA 3501. Safety standards KTA 3507, KTA 3503 and KTA 3505 are also of major relevance.

(6) The requirements specified in safety standard KTA 3403 for function tests have been taken into account in the present safety standard.

(7) With respect to switch gear and actuators, specific delimitations are formulated in the scope of the present safety standard that are in full agreement with safety standards KTA 3701 to 3705 and KTA 3504.

(8) The requirements of the safety standard KTA 3904 have been taken into account in the present safety standard.

(9) Safety standards KTA 1401, KTA 1402, KTA 1403, KTA 1404, and KTA 1202 are considered as superordinate standards for the entire nuclear power plant.

1 Scope

(1) This safety standard applies to the system tests of the instrumentation and control systems important to safety of nuclear power plants. It applies to those instrumentation and control equipment performing functions of Categories A, B or C according to KTA 3501.

Notes:

The present safely standard does not specify any requirements concerning conventional safety aspects, e.g., health and safety protection at the workplace.

(2) The system tests of the instrumentation and control system important to safety include system tests in test fields, commissioning tests and inservice inspections. Not included in these tests are the tests performed in the course of fabrication and assembly, nor the tests on the electrical systems of the power supply. The latter are dealt with in safety standards KTA 3701 to KTA 3705.

2 Definitions

(1) Integral function test

The integral function test is a test intended to verify the proper function of an instrumentation and control system by checking the reaction of the signal output to a certain signal input.

(2) Authorized expert

An authorized expert is a qualified person or organization consulted on the basis of AtG, Sec. 20, by the nuclear licensing of supervisory authority.

3 Superordinate Test Requirements

3.1 Basics

(1) System tests shall be performed to completely verify that, on the one hand, the instrumentation and control systems important to safety were fabricated and assembled in accordance with those documents design-reviewed by the authorized expert and, on the other, that they fulfill their designated functions.

(2) In the case of a step-by-step performance of the tests, the functioning of the instrumentation and control equipment shall be verified by overlapping and well coordinated test segments. In this context, it is permissible to employ the self-monitoring functions of the system, provided, the effectiveness of these tests have been verified. The function tests shall normally include actuation and operation of the drives (e.g. electrical motors, actuators, solenoid valves) to such extent that the feedback signals can be tested.

(3) If the system tests uncover any errors, their causes and effects shall be analyzed and the causes eliminated.

(4) It shall be verified by inservice inspections in specified intervals that the instrumentation and control systems important to safety are able to fulfill their tasks. Integral function tests shall basically be included in the inservice inspections of the instrumentation and control equipment performing functions of Categories A or B. The test intervals for the integral function tests shall be specified dependent on the effectiveness of the self-monitoring functions.

(5) The integral function tests may be replaced by overlapping limited-scope inspections.

3.2 Systems Required to be Tested

All instrumentation and control equipment performing functions of Category A, B or C shall be subjected to tests and inspections and tests.

Note:

This equipment to be tested includes:

a) Reactor protection system,
b) Protective limitations,
c) Limitations of process variables,
d) Controls important to safety,
e) Control level for drives important to safety,
f) Class S alarms, and
g) Class I alarms.

3.3 Configuration Management and the Configuration and Identification Documentation

3.3.1 Configuration management

(1) The functional and technical characteristics of the system specified in Section 1 as well as any modifications of these

characteristics shall be identified and documented. The technical and administrative instructions and control measures required in this context shall be specified.

(2) It is permissible to incorporate the configuration management in other administrative regulations (e.g., maintenance regulation, technical instruction).

(3) Measures provided by the configuration management shall ensure that the configuration and identification documentation is always kept up to date.

(4) In the case of software-based instrumentation and controls it shall normally be possible to check

a) that the functionality corresponds to the actual version of the specifications and that it has been verified by tests,

b) that the type tested version of the system software and hardware are truly applied,

c) that the user software truly applied was generated on the basis of valid specifications, and

d) that the associated configuration management is always updated to the latest version.

(5) It shall be ensured that all maintenance measures including commissioning are based on the configuration management.

3.3.2 Configuration and identification documentation

(1) All distinguishing features for identifying the system structure including the interfaces, the hardware components, the system software and user software components as well as the used project planning and servicing tools shall be documented.

(2) All data required for identifying the control and instrumentation system important to safety shall be recorded. In the case of older systems, the initial recording of this data may be performed in the course of maintenance measures. Depending on the instrumentation and control systems important to safety actually used, these records shall include the following data:

a) Component parts list of the instrumentation and control cabinets including production dates and series numbers of the modules (hardware / firmware),

b) Table of contents of the hardware configuration schematics (e.g., cabinet disposition plans, network diagrams, circuit diagrams),

c) List of the hardware parameters (e.g., address and jumper settings of the hardware modules) as well as of the software parameters (e.g., limit values, hystereses, time constants),

d) Software configuration (user software, system software, project planning software, servicing tools) in the form of a list of all software components with their respective version identifications and checksums, and

e) List of the user groups and their respective access rights.

(3) It shall be possible to check the configuration specified in the configuration and identification documentation for the instrumentation and control systems important to safety at their place of installation.

(4) The configuration and identification documentation may consist of different documents and may reference additional subordinate documents.

4 Commissioning Tests of the Instrumentation and Controls

4.1 Tests without Operation of the Process-Engineering Systems

4.1.1 General requirements

The tests of the instrumentation and controls without operation of the process-engineering systems shall be performed as two partial tests, namely, the visual inspections and the function tests.

Note:
The tests without operation of the process-engineering systems may be partitioned as tests in the test field and as tests at the final place of installation.

(2) It is permissible to use simulators for the tests in the test field and for the commissioning tests in the power plant. The suitability of the simulators and simulation models employed shall be verified.

4.1.2 Visual inspections

(1) At the beginning of the tests without operation of the process-engineering systems, visual inspections of the instrumentation and control systems important to safety shall be performed both in the test field and in the power plant on the basis of the documents design-reviewed by the authorized expert.

(2) With these inspections it shall be verified that a correct functioning can be expected on the basis of the layout of the instrumentation and control equipment taking into account the arrangement of the other power plant components (e.g., the mechanical and electrical components, the ventilation and air filtration systems), and that maintenance possibilities are provided. Test criteria include:

a) Completed fabrication and component assembly and software implementation in accordance with the configuration and identification documentation of that part of the instrumentation and control equipment to be tested,

b) Physical integrity of that part of the instrumentation and control equipment to be tested,

c) Suitable construction with regard to the function of the mechanical parts of the measurement assemblies (e.g., sensors, sampling lines, transducers),

d) Comprehensive marking of all devices, modules and cabinets and their correct allocation to the redundancy groups,

e) Protection against mechanical impacts (e.g., resulting from maintenance work in the plant) of that part of the instrumentation and control equipment to be tested, and

f) Accessibility of the devices, modules and measurement assembly arrangements with regard to tests, servicing and repairs.

(3) The visual inspections shall not be carried out before all accompanying tests of those parts of the instrumentation and control systems important to safety to be tested are completed, and not before the assembly tasks in the compartments accommodating the instrumentation and control equipment to be tested has reached a stage where further assembly tasks can no longer have any detrimental effects on the systems tested with respect to the test criteria specified in para. (2) above.

4.1.3 Function tests

(1) The function tests shall be carried out at the final location of installation and shall verify that the instrumentation and control equipment fulfills the functions specified in the documents design-reviewed by the authorized expert (e.g., overview diagrams, functional diagrams, circuit diagrams, measuring circuit data sheets, functional descriptions, specifications, explanatory reports).

(2) Integration tests shall be performed with the instrumentation and control equipment of the power plant (e.g., process computer, hazard alarm facility, control room displays, feedback signals).

(3) The function tests shall normally be performed together with the mechanical and electrical components by checking the feed-back signals from actuators, solenoids and circuit breakers created when triggering the components. The process-engineering systems do not need to be in operation for these tests. In the case of media-derived signals (e.g., pressure, flow) the physical values may be created by auxiliary testing aids.

(4) The characteristics specified for the system shall be checked. This shall include checking

a) that the specified temporal behavior (e.g., delay times, lag times) are not exceeded,

b) that the specified maximum loads (e.g., CPU, network) are not exceeded,

c) that the specified error and re-starting behavior is achieved, and

d) that the measures regarding access protection are effective.

(5) Those wiring and function tests of system parts which have already been carried out in the test field as well as any integral system tests already performed do not have to be repeated at the final location of installation, provided,

a) the scope and documentation of these tests meet the requirements specified in this Section 4.1,

b) neither the transportation not the assembly and integration of the instrumentation and control equipment into the power plant in any way affect the previously tested characteristics and behavior of the instrumentation and control, and

c) overlapping tests as specified in Section 4.7 were carried out in the case of modifications.

Note:
Factory tests are dealt with in safety standard KTA 3507.

4.1.4 Commissioning test schedule

Before starting with the tests without operation of the process-engineering systems, a commissioning test schedule shall be established and precisely coordinated with the authorized expert. This commissioning test schedule shall specify the systems and system components, the tests and inspections to be performed, the associated commissioning test instructions and the participation of the authorized expert. This commissioning test schedule may be incorporated in mutual commissioning test schedules for the testing of electrical and process-technological systems.

4.1.5 Commissioning test instructions

(1) Before starting with the tests without operation of the process-engineering systems, commissioning test instructions shall be established for these parts of the instrumentation and control systems important to safety to be tested and shall be precisely coordinated with the authorized expert.

(2) A commissioning test instruction shall be comprised of the procedural description of the individual commissioning test and the corresponding test record form sheets.

(3) The procedural task description of the commissioning test instruction shall include information regarding:

a) Designation including state of revision that will ensure proper allocation of the procedural task description to the commissioning test schedule,

b) Description of the test procedure in which the test procedure and the process of performing the test are specified and in which, basically, the measurement-technological test setup is described in the form of a circuit schematic. The description of the measurement-technological test setup is not required in the case of simple test setups.

c) Test criteria for the visual inspections as specified under Section 4.1.2,

d) Documents on which the test is based, und

e) Auxiliary testing aids including the necessary technical data.

(4) The corresponding test record form sheets of these commissioning test instructions shall include:

a) Information on the test object including its place of installation or testing and its alpha-numeric plant identification code,

b) Specification of the associated procedural task description,

c) Listing of the tests by the individual test steps that are required to be documented, and

d) Measurement values to be accumulated together with their required values and tolerances.

(5) In the course of testing, the following data shall be entered in the test record form sheets:

a) Specification of the measurement devices used including the device identification numbers,

b) Version of the configuration and identification documentation,

c) Test results of the individual test steps (*together with the*,

d) Adjusted value settings, and

e) Confirmation of a successful test after removal of any defects by the signature of the tester with the test date and, in case of participation, the signature of the authorized expert.

N o t e :
By these data entries, the test record form sheet becomes the test record.

4.2 Tests Regarding Interaction with the Process-Engineering Systems

4.2.1 General requirements

(1) The tests of the instrumentation and control systems important to safety regarding interactions with the process-engineering systems shall be performed during commissioning of the process-engineering systems. In accordance with the operating states achieved, the commissioning tests of the instrumentation and control equipment shall be performed in coordination with the process-engineering systems. It shall be tested whether or not the instrumentation and control system important to safety

equipment fulfills the requirements specified in the valid documents under the actual operating conditions.

(2) The measures to be initiated by the instrumentation and control systems important to safety shall be tested by activating the corresponding process-engineering conditions or – whenever this would lead to an excessively high loading of the power plant – by simulating the activation.

(3) If an excessively high loading of the plant facility would result from the activation measures of the test then, keeping the test objective in mind, the loading of the plant facility shall be limited in coordination with process engineering.

(4) The tests shall normally be performed under non-nuclear operating conditions (during sub-critical operating phases). Tests for which the nuclear operation of the plant is required may be performed during the operating phases required for achieving the test objective, provided, this is permissible under safety-related considerations.

4.2.2 Prerequisites for performing these tests

(1) The tests without operation of the process-engineering systems of those parts of the instrumentation and control systems important to safety to be tested shall have been completed. The following documents shall normally be available for the tests under this Section 4.2:

a) Conceptual schematics (e.g., limit signal processing plan, logic diagram),

b) Function diagrams (e.g., interlock logic plan),

c) Circuit diagrams,

d) Measuring circuit data sheets, and

e) List of the valid adjustment settings.

(2) The individual tests of the interaction with the process-engineering systems shall only be performed if the process-engineering systems or partial systems required for these tests are fully functional.

(3) Before starting with the tests regarding interaction with the process-engineering systems, a commissioning test schedule and the commissioning test instructions shall be established and precisely coordinated with the authorized expert.

4.2.3 Commissioning test schedule

The tests regarding interaction with the process-engineering systems shall be included in the commissioning test schedule under Section 4.1.4. This commissioning test schedule shall specify the systems and system components, the tests and inspections to be performed, the associated commissioning test instructions and the participation of the authorized expert. This commissioning test schedule shall normally be incorporated in mutual commissioning test schedules for the testing of electrical and process-technological systems.

4.2.4 Commissioning test instructions

(1) A commissioning test instruction shall be comprised of a procedural task description for the individual commissioning test and the corresponding commissioning test record form sheets.

(2) The procedural task description for these commissioning test instructions shall include information regarding

a) Designation including the state of revision that will ensure proper allocation of the procedural task description to the commissioning test schedule,

b) Version of the configuration and identification documentation

c) Description of the test procedure and of the procedural tasks for the execution of the test.

d) Test conditions (e.g., plant and system conditions),

e) Documents on which the test is based, und

f) Auxiliary testing aids to be used in addition to the power plant instrumentation including the necessary technical data.

(3) The individual test record form sheets of these commissioning test instructions shall include:

a) Information on the test object including its place of installation or testing and its alpha-numeric plant identification code,

b) Specification of the associated procedural task description,

c) Listing of the tests in the form of individual test steps that are required to be documented, and

d) Measurement values to be accumulated together with alpha-numeric plant identification code,

(4) In the course of testing, the following data shall be entered in the test record form sheets:

a) Specification of the measurement devices used in addition to the power plant instrumentation including the device identification numbers,

b) Test results of the individual test steps,

c) Evaluation of the test results from the standpoint of process engineering, and

d) After removal of any defects, confirmation of a successful test by the signature of the tester with the test date and, in case of participation, the signature of the authorized expert.

N o t e :
By these data entries, the test record form sheet becomes the test record.

4.3 Requirements Regarding Auxiliary Testing Aids

The commissioning tests shall be performed with the auxiliary testing aids specified in the corresponding commissioning test instruction. The auxiliary testing aids used in addition to the power plant instrumentation shall be subjected to servicing and calibration in accordance with safety standard KTA 1401, Sec. 10. The performed check and the date of the next check shall be perceptibly marked on the auxiliary testing aids or in the documentation accompanying the auxiliary testing aids. The simulators and simulation models used for the tests in the test field and for the commissioning tests in the power plant shall be specified. The suitability of the simulators and simulation models employed shall be verified.

4.4 Testers

The commissioning tests shall be performed by qualified personnel appointed by the license applicant. Insofar as specified in the commissioning test schedule, the authorized expert shall be called in to participate in these tests.

4.5 Documentation

The commissioning test shall be documented by the following documents:

a) Commissioning test schedule,

b) Commissioning test instructions, and

c) Commissioning test records.

These documents shall be stored by the operating utility over the length of time that the tested component of the instrumentation and control systems important to safety is in use.

4.6 Testing after Repairs

If repairs are carried out during or after completion of a commissioning test, the affected partial sections of the instrumentation and control systems important to safety shall be subjected to renewed overlapping tests in accordance with the commissioning test instructions specified in Sections 4.1.5 and 4.2 4. These tests shall be documented.

4.7 Testing after System Modifications

4.7.1 Basics

If modifications of the instrumentation and control system or other modifications affecting the instrumentation and control systems important to safety are deemed necessary during or after completion of a commissioning test, the affected partial sections of the instrumentation and control systems important to safety shall be subjected to renewed overlapping tests in accordance with commissioning test instructions as specified in Sections 4.1.5 and 4.2 4 as soon as the modifications have been carried out and the associated test documents have been revised. The modifications and the scope of the tests shall be precisely coordinated with the authorized expert. These tests shall be documented as specified in Section 4.5.

4.7.2 Software modifications

In the case of digital, software-based instrumentation and control systems important to safety, the additional quality assurance measures required to be performed within the framework of repair tasks or modifications shall be specified in quality assurance instructions. These instructions shall include the requirements and procedural steps regarding the planning, implementation, verification and validation as well as the recording and documentation of the repair tasks or system modifications.

4.7.2.1 Software modifications of instrumentation and control equipment performing functions in Category A

(1) The software modification shall be specified. The procedure of performing the modification shall normally follow the procedure of the phase model which was the basis for the software development procedure. The extent and the repercussions of the software modifications shall be clearly stated. All phases of the software development procedure shall be checked as to whether or not they are affected by the modification. Those phases affected shall be repeated.

(2) The software modification shall be performed such that a complete verification of the software regarding its correct operating modes is ensured. Planning and implementation shall be performed using formalized and computer-aided design and testing procedures. All software modifications shall be performed using computer-aided tools.

(3) All results of the individual phases of the software modification shall be verified with respect to the specifications by applying formal analysis methods and additional tests. In this context, tests shall be performed at the phase transitions, and the test results shall be documented.

(4) After upgrading the computers to the modified software the required behavior of the hardware and software system shall be validated. If this validation is performed in multiple steps, the individual validation steps shall overlap one another.

(5) The organization and administration during software modification shall be such to ensure that the software is realized based on the complete design, testing, servicing and quality assurance plans. It shall be ensured that project tasks and quality assurance are strictly independent of each other.

(6) The correct working and effectiveness of the modifications shall be verified. In this context, it shall be verified, in particular, that the required function is performed and that no impermissible effects (impact assessment) are caused in unmodified parts of the system or in other systems. Depending on the type and extent of the modification, it is permissible to perform this verification by applying a test configuration.

(7) It shall be validated that the behavior of the modified hardware and software system is as specified.

(8) Modifications of the system software, firmware or operating system software shall be treated the same as equipment modifications.

4.7.2.2 Software modifications of the instrumentation and control equipment performing functions in Category B

(1) Any software modification shall be performed in accordance with the requirements specified under Section 4.7.2.1, paras. (1), (5), (6), (7) and (8).

(2) The verification of the proper working order shall normally be supported by computer-aided test procedures. The type and extent of the verification procedure shall be precisely coordinated with the authorized expert.

(3) The software modification shall normally be performed using computer-aided tools.

4.7.2.3 Software modifications of the instrumentation and control equipment performing functions in Category C

(1) Any software modification shall be specified, indicating the individual modification steps. The modification steps should be performed using software development tools.

(2) The finalized modification steps shall be verified by tests and shall be documented.

(3) It shall be validated that the behavior of the modified hardware and software system is as specified with regard to its safety-related functions. The type and extent of the validation procedure shall be precisely coordinated with the authorized expert. The software modification shall be performed in accordance with a quality assurance program.

5 Inservice Inspections of the Instrumentation and Control systems important to safety

5.1 General Requirements

(1) The instrumentation and control equipment performing functions of Categories A or B shall basically be subjected to inservice inspections in specified time intervals during their entire operating life in the power plant, in order to verify the proper functioning of this equipment.

(2) Inservice inspections are not required for those partial sections of the instrumentation and control equipment that are tested by self-monitoring functions. These self-monitoring functions shall be specified and shall meet the following requirements:

a) An analysis shall be performed aimed at identifying the presumed types of failures that can be detected by the self-monitoring functions.

b) The effectiveness of the applied self-monitoring functions shall be checked within the framework of the qualification of the components of the instrumentation and control equipment (system immanent) or within the framework of the commissioning test (project oriented).

c) The malfunctions detected by the self-monitoring functions shall be signaled and displayed by Class I alarms or qualitatively similar alarms.

(3) Inservice inspections shall not impair the measures to be initiated by instrumentation and control equipment performing functions of Categories A or B in any way that may impermissibly reduce the effectiveness of the instrumentation and control systems important to safety.

(4) It shall normally be possible to perform the inservice inspections easily and without altering the wiring by using auxiliary testing aids (e.g., test fixtures, test sockets)

(5) The first inservice inspection of the instrumentation and control equipment performing functions of Categories A or B shall basically be performed prior to initial criticality of the power plant. Systems required for the initial fueling the reactor core shall be tested prior to fueling. In case plant-engineering prohibits performing any inservice inspections prior to initial criticality, these inspections may be postponed until the commissioning phase at 100 % power, provided this is permissible under safety-related aspects. If this permissibility is not given, substitute tests shall be performed that shall be precisely coordinated with the authorized expert.

(6) It is permissible to accept parts of the commissioning tests specified in Section 3 first inservice inspection, provided, the following criteria are met:

a) The test instruction including applied auxiliary testing aids and test steps shall be identical to the test instruction of the inservice inspection.

b) The time interval since performing the commissioning test shall not be larger than the test interval specified for the inservice inspection.

c) The test instruction specified under Section 5.5 shall be available at the point in time of accepting the commissioning test as the first inservice inspection.

d) No assembly or modification tasks may have been performed that could have detrimentally affected the tested instrumentation and control systems important to safety.

(7) The extent of the inservice inspections of the instrumentation and control equipment performing functions of Category C shall be specified dependent on the individual functions.

5.2 Prerequisites for Performing Inservice Inspections

(1) Before beginning with the inservice inspections of the instrumentation and control systems important to safety, an inservice inspection test schedule and the inservice inspection test instructions shall be available and shall have been precisely coordinated with the authorized expert.

(2) The power plant shall be brought into the condition specified in the inservice inspection test instruction of the instrumentation and control systems important to safety.

(3) In this context, it shall be taken care that no less than the minimum number of partial systems of the process-engineering systems and instrumentation and control equipment are available at all times as specified in the operating handbook.

5.3 Inservice Inspection Test Intervals

(1) The test intervals for the inservice inspections of the instrumentation and control systems important to safety shall be specified on the basis of operating experience and reliability analyses and in precise coordination with the authorized expert. On the basis of these test intervals, the dates of the regular inservice inspections and permissible deviations from these dates shall be specified.

(2) It is permissible to suspend any tests of those systems that do not need to be operable due to the condition of the power plant. Instead, new points in time for the regular inservice inspections may then be specified. All suspended tests shall be replaced by inservice inspections to be performed before or during restart of the system or of the power plant.

5.4 Inservice Inspection Test Schedule

(1) The inservice inspection test schedule specified in Section 5.2, para. (1) shall list the inservice inspections of the instrumentation and control systems important to safety. The inservice inspection test schedule shall specify the systems and partial systems to be tested, furthermore, the tests and inspections to be performed with their associated test intervals, the corresponding inservice inspection test instructions and the participation of the authorized expert.

N o t e :

Further requirements for the test schedule are specified in safety standard KTA 1202.

(2) Based on the test results and operating experience, the inservice inspection test schedule and test instructions shall be updated in precise coordination with the authorized expert.

5.5 Inservice Inspection Test Instructions

(1) An inservice inspection test instruction shall comprise the procedural task description and the test record form sheets.

(2) The procedural task description shall include:

a) Designation including the state of revision that will ensure proper allocation of the procedural task description to the associated test schedule,

b) Description of the test procedure in which the test procedure and the process of performing the test are specified and in which, basically, the measurement-technological test setup is described in form of a circuit schematic. In the case of simple test setups, the description of the measurement-technological test setup may be omitted.

c) Conditions and prerequisites for the test (e.g., power plant and system condition), and

d) Type of auxiliary testing aids needed to be used in addition to the power plant instrumentation including the necessary technical data.

(3) The test record form sheets shall include:

a) Information on the test object including its place of installation or testing and its alpha-numeric plant identification code,

b) Specification of the associated procedural task description,

c) Listing of the tests by the individual test steps that are required to be documented,

d) Specification of the test simulation measures, and

e) Measurement values to be accumulated together with the alpha-numeric plant identification code, the required values and tolerances.

(4) In the course of testing, the following data shall be entered in the test record form sheets:

a) Specification of the measurement devices used in addition to the power plant instrumentation, including the device identification numbers,

b) Test results of the individual test steps,

c) Adjustment settings found and the newly adjusted settings,

d) Specification of the defects found and the measures initiated for the removal of these defects,

e) Confirmation of the creation and later annulment of the simulation condition,

f) Reasons for any deviation from the test instruction,

g) Evaluation of the test results, and

h) Signature of the tester with the test date and, in case of participation, the signature of the authorized expert.

Note:
By these data entries, the test record form sheet becomes the test record.

5.6 Requirements Regarding Auxiliary Testing Aids

The inservice inspection shall be performed with the auxiliary testing aids specified in the associated inservice inspection test instruction. The auxiliary testing aids used in addition to the power plant instrumentation shall be subject to servicing and calibration in accordance with safety standard KTA 1401, Sec. 10. The performed check and the date of the next check shall be perceptibly marked on the auxiliary testing aids or in the documentation accompanying the auxiliary testing aids. The test procedures controlled by the auxiliary testing aids shall be designed such that the intended procedure of the tests is documented in the test record. It shall normally be recognizable that the software-controlled test procedures have been completely executed. The version of the test software shall be documented.

5.7 Testers

The inservice inspections shall be performed by qualified personnel appointed by the licensee. Insofar as specified in the inservice inspection test schedule, the authorized expert shall be called in to participate in these tests.

5.8 Documentation

The inservice inspections shall be documented by the following documents:

a) Inservice inspection test schedule,

b) procedural task description, and

c) Inservice inspection test records.

These documents shall be stored by the operating utility over the length of time that the tested component of the instrumentation and control systems important to safety is in use.

5.9 Tests after Repair Tasks

If repair tasks are performed during inservice inspections or after their completion, the affected partial sections of the instrumentation and control systems important to safety shall be subjected to renewed overlapping tests in accordance with the commissioning test instructions specified in Sections 4.1 and with the inservice inspections. The modifications and the extent of testing shall be precisely coordinated with the authorized expert. These tests shall be documented as specified in Sections 5.8.

5.10 Inservice Inspections after Release Switching and Simulations

If any release switchings and simulations are performed on partial sections of the instrumentation and control systems important to safety that, if continued, would detrimentally affect the function of the instrumentation and control systems important to safety, then the affected partial section shall be subjected to renewed overlapping inservice inspections after discontinuing the measures. These test shall be documented as specified in Section 5.8.

5.11 Tests after System Modifications

If system modifications or other modifications affecting the instrumentation and control systems important to safety are necessary, then the affected partial sections of the instrumentation and control systems important to safety shall be subjected to renewed overlapping tests after completing these modifications. These test shall be documented as specified in Sections 4.5 and 5.8.

Appendix A

Regulations Referred to in this Safety Standard

(Regulations referred to in this 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 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 January 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 of SiAnf	(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)
KTA 1202	(2017-11)	Requirements for the operating manual (Safety standard revision draft)
KTA 1401	(2017-11)	General requirements regarding quality assurance (Safety standard revision draft)
KTA 1402	(2017-11)	Integrated management systems for the safe operation of nuclear power plants (Safety standard revision draft)
KTA 1403	(2017-11)	Ageing management in nuclear power plants
KTA 1404	(2013-11)	Documentation during construction and operation of nuclear power plants
KTA 3403	(2015-11)	Cable penetrations through the reactor containment vessel
KTA 3501	(2015-11)	Reactor protection system and monitoring equipment of the safety system
KTA 3503	(2015-11)	Type testing of electrical modules for the instrumentation and control systems important to safety
KTA 3504	(2015-11)	Electrical drive mechanisms of the safety system in nuclear power plants
KTA 3505	(2015-11)	Type testing of measuring sensors and transducers of the instrumentation and control systems important to safety
KTA 3507	(2014-11)	Factory tests, post-repair tests and certification of satisfactory performance in service of modules and devices for the instrumentation and controls of the safety system
KTA 3701	(2014-11)	General requirements for the electrical power supply in nuclear power plants
KTA 3702	(2014-11)	Emergency power facilities with Diesel generator units in nuclear power plants
KTA 3703	(2012-11)	Emergency power facilities with batteries and AC/DC converters in nuclear power plants
KTA 3704	(2013-11)	Emergency power facilities with DC/AC converters in nuclear power plants
KTA 3705	(2013-11)	Switchgear, transformers and distribution networks for the electrical power supply of the safety system in nuclear power plants
KTA 3904	(2017-11)	Control room, remote shutdown station and local control stations in nuclear power plants