

Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 3904 (2017-11)

**Control Room, Remote Shutdown Station and Local
Control Stations in Nuclear Power Plants**

(Warte, Notsteuerstelle und örtliche Leitstände in Kernkraftwerken)

The previous version of this safety
standard was issued in 1988-09 and 2007-11

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

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Control Room, Remote Shutdown Station and Local Control Stations in Nuclear Power Plants

KTA 3904

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2007-11 (BAnz. No. 9a of January 17, 2008)

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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 05, 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) Based on the Safety Requirements for Nuclear Power Plants and their Interpretations this safety standard specifies the requirements for the design and construction of the main control room, the remote shutdown station and the local control stations, including their ergonomic-technical design.

(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) Detailed requirements for the design and construction of control rooms in nuclear power plants are specified in

DIN EN 60964	Nuclear power plants - Control rooms - Design,
DIN EN 60965	Nuclear power plants - Control rooms - Supplementary control room for reactor shutdown without access to the main control room,
DIN IEC 61227	Nuclear power plants - Control rooms - Operator controls,
IEC 61771	Nuclear power plants - Main control room - Verification and validation of design,
DIN EN 61772	Nuclear power plants - Control rooms - Application of visual display units (VDUs),
DIN EN 61839	Nuclear power plants - Design of control rooms - Functional analysis and assignment,
DIN EN 62241	Nuclear power plants - Main control room - Alarm functions and presentation,
DIN EN 61226	Nuclear power plants - Instrumentation and control systems important to safety - Classification of instrumentation and control functions, and
DIN EN 62138	Nuclear power plants - Instrumentation and control important for safety - Software aspects for computer-based systems performing category B or C functions.

(5) The workplaces of control stations addressed in this safety standard are not considered to be office-type computer workstations.

1 Scope

This safety standard shall be applied to the planning, design and operation of the main control room, of the remote shutdown station and of the local control stations for safety-related systems and facilities in the nuclear power plants.

Note:

The major and system control stations in the main control room, the control stations in the remote shutdown station and in the local control stations are collectively referred to as "control stations" below.

2 Definitions

(1) Local control station

A local control station is a facility outside of the main control room from which it is possible to monitor and control individual systems.

Note:

Local control stations are located at different localities in the nuclear power plant according to the system they are associated with.

(2) Remote shutdown station

The remote shutdown station is a facility outside of the main control room which, in case of a failure of the main control room, can be used to drive the nuclear reactor down to undercriticality, to keep it in the undercritical state and to monitor and control the heat removal from the nuclear reactor.

(3) Main control room

The main control room (synonymous with "main control room of a nuclear power plant unit") is the central location from which the operation of a nuclear power plant unit is monitored and controlled.

Part of the main control room are the actual control room and the adjoining rooms (control room annex).

3 Requirements for Main Control Room, Remote Shutdown Station and Local Control Stations

3.1 General Requirements

(1) One main control room as specified in Section 4 shall be provided and one remote shutdown station as specified in Section 5 shall basically be provided. If a functional failure of the main control room is prevented by a corresponding design of the power plant, the requirement for a remote shutdown station may be waived. Local control stations as specified in Section 6 are permissible.

(2) The control room, the remote shutdown station and the local control stations shall contain such equipment which permit the control, monitoring and operation of the associated systems during all plant conditions in which the process control, monitoring and operation of these systems is required.

(3) If control stations are equipped with computer-based process information systems, these shall be qualified to be in accordance with the safety relevance of the control stations.

Note:

Graded qualifying requirements are specified in DIN EN 62138.

(4) Taking ergonomic aspects into consideration, the workplaces, work tools, work procedures and work environments shall be designed, and the tasks shall be assigned to the personnel and the instrumentation and control systems, in such a way as to create the prerequisites for an optimal safety relevant behavior of the personnel.

(5) The design of the control stations shall provide measures to protect against human errors.

Note:

Suitable measures for this purpose include, e.g.,

- automation, and
- ergonomic design.

(6) The staffing as well as typical tasks and activities of the personnel shall be described and this description shall be the basis for the design of the main control room and the remote shutdown station.

Note:

Examples for staffing the main control room, remote shutdown station and local control stations are presented in **Appendix B**.

(7) The main control room, the remote shutdown station and the local control stations relevant to safety shall be designed and located such that the personnel can properly perform the required safety-related functions.

3.2 Special Requirements

(1) The equipment of the control stations shall be designed to resist the environmental conditions to be anticipated at the respective installation location such that they will be in functioning order in the case of required operation.

(2) Optical displays or acoustic indicators for annunciations shall basically be designed such that they can be tested. Any exceptions shall be substantiated.

(3) The requirements for the display range and the accuracy of optical displays shall be determined as a function of the respective systems. The final design of the displays shall normally be specified on a task-related and systems-interfacing basis.

(4) Redundant equipment (e.g., displays of the hazard alarm system) shall be designed and arranged such that, in the case of a single failure in one device, e.g., a component failure, the number of devices required under aspects of safety remain operable.

(5) Optical displays shall be designed and arranged such that it is possible to monitor each individual system as well as the interaction of the individual systems with other systems.

(6) The display graphics and plant schematics provided for the computer-based process information systems shall be qualified with respect to their safety relevance during their plant-specific deployment. This qualification shall also take safety-related and ergonomic aspects of the image layout into consideration.

(7) The power for the enabling and actuation devices of redundant equipment of the safety systems as well as for their displays shall be supplied from the respective redundancies.

4 Main Control Room

4.1 Tasks

- (1) From the main control room it shall be possible
- to monitor and control specified normal operation of the nuclear power plant,
 - to detect malfunctions in any safety-related system and to take appropriate actions to maintain the power plant in a safe condition,
 - to detect any design basis accident and to initiate measures that will maintain the nuclear power plant in a safe condition or transfer it into such a condition,

Note:

In accordance with safety standard KTA 3501, the protective measures transferring the reactor into a safe condition may be manual actions taken on account of hazard alarms.

- to detect any event sequences which have caused a deviation from specified normal operation and to initiate measures intended to influence these event sequences and mitigate their consequences, and
 - to initiate measures for the protection of the personnel.
- (2) The main control room shall be designed to be permanently occupied by the shift personnel.

4.2 Functional Layout

(1) The main control room shall be subdivided into task-related functional regions in order to achieve a separation of

the activities regarding process control, communication, documentation and other areas of operations control.

Note:

Typical functional subdivisions are:

- major plant control region,
- systems instrumentation and control region,
- communication region,
- recording region,
- documentation region,
- general purpose and recreation region, and
- release control region.

(2) The major plant control region shall encompass the functional controls for all power-dependently controlled systems required for the start-up to, and shutdown from, the hot subcritical state as well as their continued operation, and it shall contain the equipment for monitoring the overall power plant. The required displays and actuation equipment for these purposes shall be arranged in the major plant control region with regard to the regular position of the operator such that the displays can be observed and the actuation equipment can, both, be observed and operated.

(3) The systems instrumentation and control region shall be correlated to those systems and functions which, during full power operation, do not need to be constantly monitored or controlled or which are required only during specific plant conditions.

(4) The release control region shall normally be provided to enable handling the documents for release procedures (job instructions). The release control region shall normally be arranged such that

- the operations management documents, e.g., the operating manual and the systems wiring diagrams, are accessible
- the up-to date process information data is accessible, and
- the communication between the main control room personnel and the personnel instructed to carry out the release measures is possible with minimum disturbance of the main control room personnel.

The release control region shall contain all equipment required for the clearance of tasks as well as the equipment for handling release control documents, e.g., the release control index file, work assignment sheets, release control key system.

4.3 Spatial Arrangement

(1) The control room proper and the control room annex shall be allocated to the same security region and shall normally be located on the same building level.

Note:

To protect against disruptive actions by third parties, the nuclear power plant is divided into different security regions. Requirements for security regions are not within the scope of this safety standard.

(2) The fire alarm system shall normally be located in the control room proper. It is permissible to locate it in a room of the control room annex in close proximity of the control room proper, provided, collective alarms of the fire alarm system are provided for in the control room proper.

(3) The following equipment shall be located in the main control room

- information and control devices for the safety system,
- information devices (displays and recorders) of the accident overview measuring system in accordance with safety standard KTA 3502, and
- information and control devices of the alarm and staff paging system as well as of the communication means for telecommunications within the nuclear power plants and to the outside in accordance with Sec. 3 and Sec. 4 of safety

standard KTA 3901, respectively, and the associated recording devices.

4.4 Interior Equipment / Technical Furnishings

(1) The main control room shall be provided with auxiliary means for immediate measures in emergency situations, e.g., respiratory protection equipment, manual flood lights, fire extinguishers, mobile radiation measurement instruments, first-aid equipment.

(2) The up-to-date plant documentation shall be available in the main control room. The plant documentation comprises, at least:

- a) operating manual,
- b) emergency preparedness manual,
- c) system circuit diagrams,
- d) records of day-to-day operations, e.g., shift log, shift instructions, release control records, failure alarm log.
- e) list of persons with special training (stand-by schedules of the first-aid helpers, of the fire protection personnel, of the shift personnel),
- f) fire fighting plans,
- g) Radiological Protection Ordinance (StrlSchV),
- h) documents regarding catastrophe prevention in as far as required for the shift personnel,
- i) measuring circuit data sheets, function diagrams.

(3) The main control room shall be equipped with work tools, e.g., worktables and black boards (flip charts).

4.5 Design Requirements Regarding Failure-Inducing Events as well as External Influences and Events

(1) The safety-related requirements for the design of the main control room and the remote shutdown station regarding failure-inducing events as well as external influences and events shall be correlated with the protective design concept of the nuclear power plant.

(2) The main control room shall be designed at least against the effects from the following events and influences:

- a) design basis accidents within the power plant including radioactive radiation,
- b) earthquakes,
- c) flooding, and
- d) lightning strokes, storms, snow loads.

(3) The nuclear power plant shall be designed such that the main control room and the remote shutdown station cannot mutually fail in case of the following events:

- a) airplane crash,
- b) plant external explosion and dangerous substances,
- c) plant external and plant internal fire, and
- d) internal flooding.

The protection against these events may be achieved by a spatial separation of the main control room and remote shutdown station, by a mechanical protection or by a combination of these two.

(4) The safety-related equipment of the main control room shall be designed such that the safety-related functions needed in case of a required operation during the events and influences specified in paras. 2 and 3 remain operable. The other equipment of the main control room shall not impermissibly impair the function of safety-related equipment.

Note:

Safety standard KTA 3901 specifies requirements for technical measures to ensure that the communication equipment to the

outside cannot impermissibly impair safety-related equipment of the nuclear power plant.

(5) The main control room shall be located, designed, shielded, protected, illuminated, ventilated and supplied with emergency power such that the personnel can permanently occupy, enter and leave the main control room even in case of the events and influences specified in para. 2. This also applies to events according to paragraph 3, as far as the control room is designed for this.

5 Remote Shutdown Station

5.1 Tasks

(1) The following specifications shall apply only if a remote shutdown station must be provided as specified in Section 3.1 para. 1.

(2) In case of required operation with an intact reactor coolant circuit, the remote shutdown station shall enable

- a) monitoring the reactor from full power operation to a safe shutdown state, transferring the reactor into the safe shutdown state and maintaining it in this state,
- b) as far as necessary, initiating and monitoring the removal of residual heat generated by the spent fuel elements stored in the nuclear power plant.

(3) The remote shutdown station shall be ready for operation at all times during specified normal operation of the nuclear power plant.

5.2 General and Technical Furnishings

With regard to fulfilling the tasks specified in Section 5.1, the remote shutdown station or, if available, the annex to the remote shutdown station shall be equipped or provided with the following general or technical equipment:

- a) information devices (displays and recorders) of the accident overview measuring system in accordance with safety standard KTA 3502, in as far as these must be available in the remote shutdown station,
- b) information and control devices for those systems and their auxiliary systems that are required for fulfilling the tasks specified in Section 5.1 para. 2 items a) and b),
- c) information and control devices for the fire alarm system in accordance with safety standard KTA 2101.1 in as far as this is required by the plant design against fire and external events,
- d) communication means in accordance with safety standard KTA 3901 to all building sections that house systems and components needed in the case of required operation, as well as one voice communication line to the outside of the nuclear power plant,
- e) operating manual and emergency preparedness manual for the entire nuclear power plant with those parts especially marked that are required for the tasks specified in Section 5.1 para. 2 items a) and b),
- f) documents regarding catastrophe prevention in as far as these are required for the operating personnel,
- g) auxiliary means for immediate measures in emergency situations, e.g., respiratory protection equipment, manual flood lights, fire extinguishers, mobile radiation measurement instruments, first-aid equipment,
- i) work tools, e.g., worktables and black boards. (flip charts).

5.3 Design Requirements Regarding Failure-Inducing Events and External Events

(1) The remote shutdown station shall be designed against flooding, snow loads, lightning strokes and storms. It shall,

furthermore, be designed to meet the requirements specified in Section 4.5 paras. 1 and 3.

(2) The safety-related equipment of the remote shutdown station shall be designed such that the safety-related functions needed in case of a required operation remain operable. The other equipment of the remote shutdown station shall not impermissibly impair the function of the safety-related equipment.

(3) The remote shutdown station shall be located, designed, shielded, protected, illuminated, ventilated and supplied with emergency power such that, in case of a required operation, the personnel can permanently occupy, enter and leave the remote shutdown station.

(4) Neither the instrumentation and controls, nor the communication means, nor the recording devices and the documentation need to be located in separate rooms. Sufficient space for the viewing of documents shall be available.

6 Local Control Stations

6.1 Permissibility

Local control stations for safety-related equipment are permissible, provided, one of the following requirements are met by the associated system:

- a) It is an automatically operating system which, after its commissioning, does not, or not on a daily basis, require manual actions during specified normal operation of the nuclear power plant.
- b) During process control a direct, e.g., visual or audible, contact exists between the personnel and the corresponding process.

6.2 Tasks

Local control stations shall be designed such that, during specified normal operation and, as far as required, during the course of design basis accidents, it is possible to monitor and operate the associated systems. Any tasks not immediately connected to process control of the associated system may be handled by equipment in the main control room, e.g., recording of operating procedures.

6.3 General and Technical Furnishings

(1) The local control stations shall be equipped with the following devices:

- a) information and control devices required for the process control of the associated systems,
- b) recording devices for the operating procedures of the associated systems, provided, a recording is necessary and not handled at a different location.

(2) The local control stations shall, furthermore, be equipped with the following general and technical furnishings:

- a) required communication means in accordance with safety standard KTA 3901 for communicating with the local

control stations and the main control room (one intercom station of the telecommunication facility for in-plant communication). The intercom stations shall be installed inside the local control stations or in their immediate vicinity.

- b) required operating instructions for the process control of the associated system,
 - c) technical means for illumination, ventilation and, if necessary, noise insulation.
- (3) Collective failure alarms shall be displayed in the main control room to enable evaluating the condition of the locally performed process control of the systems.

6.4 Design Requirements Regarding Failure-Inducing Events and External Events

The local control stations shall be designed for the same failure-inducing and external events that have to be considered for the associated systems. The general and technical equipment of the local control stations shall not impermissibly impair the function of the safety-related equipment.

7 Tests and Maintenance

7.1 Design Review

In connection with the concept of the nuclear power plant and the data required in accordance with Sec. 3.R para. 1 ZPI, the authorized expert (under Sec. 20 Atomic Energy Act) shall examine the concepts of the different control stations to verify that they meet requirements under this safety standard.

7.2 Construction and Function Tests

(1) The authorized expert (under Sec. 20 Atomic Energy Act) shall examine whether the construction meets the specifications and the design requirements under this safety standard.

(2) The proper functioning of the main control room, of the remote shutdown station and of the safety-related local control stations shall be verified within the framework of the commissioning of the nuclear power plant as well as after any design or constructional changes.

7.3 Inservice Inspections

The type and extent of the tests, the test procedures, test intervals and the testers shall be specified in agreement with the authorized expert (under Sec. 20 Atomic Energy Act) in the test schedule.

7.4 Maintenance

(1) Any failed safety-related components of the control stations shall be exchanged or repaired without delay.

(2) After completion of the exchange or repair procedure, proper functioning of the corresponding system or device shall be verified.

Appendix A

Ergonomic-Technical Design of the Main Control Room, Remote Shutdown Station and Local Control Stations

A 1 Work System

- (1) From the beginning on of the planning stage, the ergonomic insights, data and procedures shall be systematically taken into consideration regarding the work system, the design of the main control room, remote shutdown station and local control stations. The considered work system shall normally comprise:
- the shift personnel, e.g., number, qualification and organizational structure,
 - the work tools, e.g., data management, control and communication equipment,
 - the work tasks of the control station personnel resulting from the type of nuclear power plant, its operating procedure, the requirements regarding safety and security as well as reliability, and the degree and the extent of automation, and
 - the working environment, e.g., illumination, air-conditioning.
- (2) The design shall take the difference into consideration between established and innovative parts of the work system.

Note:

The established parts of the work system are considered to be those where no essential changes have been introduced with respect to the fore-runner system.

The innovative parts of the work system are considered to be those where essential changes have been introduced with respect to the fore-runner system.

The following changes are considered to be essential:

- change in the number and qualification of the shift personnel,
- conversion from parallel to serial operation of the control or information technology, and
- change in the distribution of tasks between shift personnel and automatic systems.

- (3) In case of a simultaneous deployment of established and innovative parts in the work system, their interaction shall be taken into consideration and shall be described.

A 2 Established Parts of the Work System

The description of the established parts of the work system shall include how and in what planning period experience was gained with the fore-runner systems in nuclear power plants or comparable parts of conventional power plants. Any changes on account of operating experience or further development of proven or tested parts of the work system shall be evaluated on the basis of ergonomic-technical aspects.

A 3 Innovative Parts of the Work System

A 3.1 Tasks and Procedures

- (1) It shall be described what parts, and to what extent these parts have been changed, replaced or supplemented, and what goals shall normally be achieved by these innovations.
- (2) The process control tasks that fulfill the modified part of the work system shall be described and also which requirements shall normally be met by this modified part.
- (3) The requirements specified for the design and planning phase specified in Section A 3.2 as well as for the construction and evaluation phase specified in Section A 3.3 shall be realized in an iterative development process with an ever increasing degree of detailing corresponding to the progress of

power plant construction. In the design and planning phase different solution concepts regarding the adjustment to the limits of human abilities and performance standards shall be analyzed and evaluated. These analyses and evaluations (procedures as specified in Section A 3.4) shall be performed in collaboration with the later assigned personnel as well as with experts in the various disciplines of engineering, ergonomics and work psychology. The procedures and criteria applied in performing the analysis and evaluation shall be documented.

- (4) The results of this decision making process (choice of relatively best solutions and elimination of possibly remaining weaknesses) shall be documented and substantiated. Likewise, the changes in already publicized technical descriptions as a result of these decisions shall be documented and substantiated.

A 3.2 Design and Planning Phase

- (1) The tasks which will be performed by the autonomous instrumentation and controls and those which the personnel shall normally perform with the help of instrumentation and controls shall be specified.

(2) Those tasks which the personnel shall normally perform with the help of the instrumentation and controls shall be used as the basis for developing the requirements for the quality of the work tools, work places and work environments under consideration of the ergonomic criteria and requirements specified in this safety standard.

- (3) The resulting tasks to be performed by the shift personnel shall be evaluated, and it shall be certified that the process control tasks, under consideration of ergonomic insights, can be performed such that the prerequisites for an optimum safety-related behavior of the personnel are given.

A 3.3 Construction and Evaluation Phase

- (1) The arrangement, allocation and construction of work tools as well as the physical factors of the work environment shall be checked.

(2) It shall be checked that it is possible to perform the process control tasks (tasks by the autonomous instrumentation and controls and by the shift personnel) for the innovative parts of the system and also that the performance of these tasks are integrated into the process control of the overall power plant such that the requirements specified in Section 3.2 para. 3 are met.

A 3.4 Analysis and Evaluation Procedures

- (1) All tasks assigned to the control station personnel for the operating modes

- full power,
- start-up and shutdown,
- refueling,
- malfunction of plant components,
- maintenance, and
- design basis accidents

of the associated power plant region or system shall be analyzed.

(2) In accordance with the development stage of the planning, the tasks shall be dissected into partial tasks that allow performing an evaluation with regard to

- a) time,
- b) accuracy of the data display,
- c) interaction with other tasks,
- d) possibility of revoking an initiated action,
- e) possible termination of the procedures, and
- f) required reliability and safety-related requirements.

(3) The task analysis shall normally take the following aspects into consideration:

- a) required and available data information for the operator,
- b) required data and information processing,
- c) decisions to be made and actions to be taken,
- d) time aspects of the tasks (e.g., required reaction times, duration of the tasks, consecutiveness with other tasks), their frequency and tolerance to a faulty response,
- e) spatial aspects of the tasks (e.g., allocation of the associated informational data and means of intervention), the work room, and
- f) conditions of performing the tasks (e.g., responsibilities, communication procedures, team work), required documents and work tools, number of required personnel.

Note:

The tasks of the operator may also extend to such procedures which, during fault-free operation, are performed by the autonomous instrumentation and control system, however, the failure of which must be detectable by the operator who will then replace them by manual actions.

(4) The different solution concepts may be evaluated by applying, e.g., the following methods:

- a) projecting basic ergonomic knowledge and application experience from comparable areas in as far as these areas are applicable and sufficient with regard to the evaluation,
- b) carrying out experiments to clarify unsolved ergonomic questions,
- c) constructing models for the evaluation of the spatial design of the innovative parts of the work system and of their integration in the overall work system, and
- d) performing simulations for the evaluation of the dynamic aspects of the innovative parts of the work system and of their dynamic interaction with the overall work system.

(5) The examination of assembled facilities during the evaluation phase shall be performed using ergonomic observation and evaluation procedures.

Appendix B

Examples for the Staffing of the Main Control Room, the Remote Shutdown Station and the Local Control Stations

<i>Mode of Operation</i>	<i>Number of Persons</i>			
	<i>Specified Normal Operation</i>			<i>Design Basis Accidents</i>
	fault-free operation	during inservice inspections	abnormal operation	
Full power operation	2 or 3	3 to 5	4 to 6	4 to 7
Start-up and shutdown	4 or 5	6 or 7	6 or 7	6 or 7
Overall maintenance during power plant shutdown	2 to 5	4 to 7	2 to 20	4 to 7

Table B-1: Staffing of the main control room

<i>Mode of Operation</i>	<i>Number of Persons</i>
Specified normal operation	0
Inservice inspection of systems carried out from the remote shutdown station	1 or 2
Inservice inspections of the remote shutdown station	0 to 2
Overall maintenance during power plant shutdown	0 to 2
Required operation of the remote shutdown station	2 or 3

Table B-2: Staffing of the remote shutdown station

<i>Mode of Operation of the System Allocated to the Local Control Station</i>	<i>Number of Persons</i>		
	fault-free operation	during inservice inspections	abnormal operation
Normal operation	0 to 2	1 or 2	1 or 2
Start-up and shutdown	1 or 2	1 or 2	1 or 2
Major maintenance (during refueling)	1 or 2	1 or 2	1 or 2

Table B-3: Staffing of the local control stations

Appendix C

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)
StrSchV		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)
ZPI	(1982-10)	Compilation of information required for review purposes under licensing and supervisory procedures for nuclear power plants (1982), Section 3.R, of October 12, 1982 (BAnz No. 6a of January 11 1983, Pages 49 and 50)
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 2101.1	(2015-11)	Fire Protection in Nuclear Power Plants; Part 1: Basic Requirements
KTA 3502	(2012-11)	Accident measuring systems
KTA 3901	(2017-11)	Communication means for nuclear power plants

Appendix D

Regulations referred to in Section Basic Principles and in the Notes of this Safety Standard

KTA 3501	(2015-11)	Reactor Protection System and Monitoring Equipment of the Safety System
DIN EN 61226	(2010-08)	Nuclear power plants - Instrumentation and control important to safety - Classification of instrumentation and control functions (IEC 61226:2009); German version EN 61226:2010
DIN EN 61839	(2015-01)	Nuclear power plants - Design of control rooms - Functional analysis and assignment (IEC 61839:2000); German version EN 61839:2014
DIN EN 62138	(2010-03)	Nuclear power plants - Instrumentation and control important for safety - Software aspects for computer-based systems performing category B or C functions (IEC 62138:2004); German version EN 62138:2009
DIN EN 62241	(2015-06)	Nuclear power plants - Main control room - Alarm functions and presentation (IEC 62241:2004); German version EN 62241:2015
DIN EN 60964	(2010-08)	Nuclear power plants - Control rooms - Design (IEC 60964:2009); German version EN 60964:2010
DIN EN 60965	(2011-12)	Nuclear power plants - Control rooms - Supplementary control points for reactor shutdown without access to the main control room (IEC 60965:2009); German version EN 60965:2011
DIN IEC 61227	(2009-01)	Nuclear power plants - Control rooms - Operator controls (IEC 61227:2008)
IEC 61771	(1995-12)	Nuclear power plants - Main control room - Verification and validation of design
DIN EN 61772	(2013-09)	Nuclear power plants - Control rooms - Application of visual display units (VDUs) (IEC 61772:2009); German version EN 61772:2013

Furthermore, the pertinent ergonomic standards regarding work environment (illumination, environmental climate, acoustics, electrostatic charging) and regarding the design of work places of control stations as well as of the displays and control elements of control stations shall be taken into account.