Safety Standards

of the

Nuclear Safety Standards Commission (KTA)

KTA 3901 (2017-11)

Communication Means for Nuclear Power Plants

(Kommunikationseinrichtungen für Kernkraftwerke)

The previous version of this safety standard was issued in 2013-11

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

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KTA 3901.1 1977-03 (BAnz No. 107 of July 11, 1977)
KTA 3901 1981-03 (BAnz No.136a of July 28, 1981, BAnz No.155 of August 22, 1981)
KTA 3901 2004-11 (BAnz No. 35a of February 19, 2005)
KTA 3901 2013-11 (BAnz of January 17, 2014)

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

Basic Principles

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

(2) Based on SiAnf and the SiAnf-Interpretations, the present safety standard specifies requirements regarding the alarm equipment and communication means.

(3) In the present safety standard, it is presumed that the conventional requirements and standards (e.g., German Occupational Accident Prevention Regulations, DIN Standards and VDE Regulations) are met taking the safety requirements specific to nuclear power plants into account.

(4) Safety-related requirements for the control room, remote shutdown station and local control stations in nuclear power plants are specified in safety standard KTA 3904.

(5) Requirements for the accident measuring system are specified in safety standard KTA 3502.

(6) Requirements for fire protection are specified in safety standards KTA 2101.1, KTA 2101.2 and KTA 2101.3.

(7) Requirements for lightning protection are specified in safety standard KTA 2206.

(8) General requirements for quality assurance are specified in safety standard KTA 1401.

(9) Requirements for the documentation are specified in safety standard KTA 1404.

(10) Requirements for the testing manual are specified in safety standard KTA 1202.

1 Scope

(1) This safety standard shall apply to the communication means inside nuclear power plants and, specifically, to the alarm systems, staff-paging systems, voice communication systems and the means for communicating from nuclear power plants to the outside.

(2) This safety standard does not contain any requirements regarding devices pertaining to process surveillance, radiological protection, fire protection, environmental monitoring and plant security.

2 Definitions

(1) Central alarm facility

The central alarm facility is an installation dedicated to the formation, amplification, synchronization and monitoring of alarm signals, and to the voice notification of the personnel.

(2) Alarm post

The alarm post is an installation dedicated to the actuation of alarms as well as to the communication inside the nuclear power plant and from the nuclear power plant to the outside, and it contains all necessary operating and monitoring equipment for these purposes.

(3) Single alarm

The single alarm is an issued signal indicating that an alarm condition applies to only one individual building or building section.

(4) All-clear signal

The all-clear signal an issued signal issued via the alarm system indicating that an alarm condition is cancelled.

(5) Fire alarm

The fire alarm is an issued signal indicating that a fire has occurred.

(6) Escape alarm

The escape alarm an issued signal indicating that everybody must immediately escape from the respective area.

(7) Group alarm

The group alarm is an issued signal indicating a state of alarm simultaneously for a group of buildings.

(8) Nuclear power plant site

The nuclear power plant site is the tract of land within correspondingly fixed boundaries that belongs to the single-unit or multi-unit nuclear power plant.

(9) Supervisory intercom system

A supervisory intercom system is a telecommunication system for the voice communication within a nuclear power plant unit, specifically, between its control room, the remote shutdown station and the telephone extensions of the safety-related local control stations and plant components.

(10) Evacuation alarm

The evacuation alarm is an issued signal indicating that an immediate orderly evacuation of the respective area is required.

(11) Collective alarm

The collective alarm is an issued signal indicating that a state of alarm is issued simultaneously for all areas of the nuclear power plant.

3 Means for Communicating Within Nuclear Power Plants

3.1 General Requirements

(1) The following communication means are required:

a) an alarm system as specified under Section 3.2,

b) staff-paging systems as specified under Section 3.3,

c) voice communication systems as specified under Section 3.4.

(2) Type and extent of the planned systems shall be specified.

3.2 Alarm System

3.2.1 Requirements regarding the conceptual design of the alarm system

(1) The alarm system of the nuclear power plant shall basically be designed to be redundant. Parts of the alarm system (e.g., the terminal equipment) may be excluded from the redundancy requirement, provided, even under assumption of a single failure it is ensured that the personnel can be alerted.

(2) An acoustic alarm system or an optical alarm system may be used.

(3) The nuclear power plant shall be divided into alarm regions such that it will be possible to issue the necessary single, group and collective alarms directly to the regions concerned.

(4) It shall be possible to inform the personnel about the reason for the issued alarm.

(5) It shall be possible to issue the alarm signal within the buildings and outside on the nuclear power plant site.

3.2.2 Design and construction of the alarm system

(1) The alarm system shall be designed and constructed such that neither a random failure of a component nor a locally confined failure-inducing event (e.g., fire) can prevent issuing an alarm.

(2) The operating controls shall be secured against inadvertent actuation.

(3) Failures in the central alarm facilities shall be indicated optically and acoustically in the control room.

(4) Redundant central alarm facilities shall be separated from each other by at least F 30 fire resistance class barriers.

(5) The central alarm facilities shall each receive their power from uninterruptible emergency power facilities that are independent of each other.

3.2.3 Actuation of alarms

(1) It shall be possible to manually actuate every alarm signal from one or more alarm posts. One of the alarm posts shall be located in the vicinity of the control room of the nuclear power plant unit.

(2) One set of operating devices for issuing the alarm signals is required at each alarm post.

(3) The signal "fire alarm" may be triggered from arbitrary locations within the nuclear power plant.

Note:

The fire alarm is generally issued as a collective alarm.

(4) Every actuated alarm shall be automatically recorded together with the time it was actuated and shall be indicated optically and acoustically at every one of the alarm posts.

(5) The following primary priorities shall be assigned to the alarm signals:

a) 1st priority Escape alarm,
b) 2nd priority Fire alarm,
c) 3rd priority Evacuation alarm,
d) 4th priority All-clear signal.

(6) Within these primary priorities the following secondary priorities shall be applied:

a) priority a Collective alarm,
b) priority b Group alarm,
c) priority c Individual alarm.

3.2.4 Alarm signals

3.2.4.1 Signals of the acoustic alarm facility

(1) The sound level of the alarm signal shall exceed the listening threshold. Therefore, the sound level shall normally be at least 15 dB(A) above the noise level of specified normal operation. If the sound level of the alarm signal is less than 15 dB(A) above the noise level of specified normal operation, then it shall be demonstrated that the alarm signal clearly exceeds the listening threshold.

(2) The maximum value of the alarm signal shall normally not exceed 110 dB(A) at one meter from the sound generator. If the absolute maximum value of the alarm signal sound level at the sound generator exceeds 110 dB(A), then the level of 110 dB(A) shall not be exceeded at possible work places.

(3) If, occasionally, the noise level exceeds a sound level of 90 dB(A), then blinking optical attention signals are required in addition to the acoustic alarm signal. The optical attention signals shall flash at a frequency of (2 ± 0,6) Hz. Their brightness shall be such that they are clearly visible against the background under all operating conditions. The color “yellow” shall be used for the optical attention signals.

(4) Acoustic alarm signals and optical attention signals shall remain activated for at least one minute. Measures shall be provided that enable interrupting the active acoustic signals at the individual alarm post for voice messages.

(5) Examples for the wave forms of the acoustic signals for the escape, fire, evacuation alarms and the all-clear signal are shown in **Table 3-1**.

3.2.4.2 Signals of the optical alarm facility

(1) The brightness of the optical alarm signals shall be well above the brightness of the environment so that they are clearly visible under all operating conditions.

(2) The color “red” shall be used for the optical alarm signal. With the exception of the alarm signals, the color “white” (incandescent lamps) may be used for codifying the signals.

(3) Optical alarm signals shall remain activated for at least two minutes and may not be interrupted within this time period; they may, however, be replaced by alarm signals of a higher priority. Flashing lights shall be used as the optical signals for the escape, fire and evacuation alarms. The signal lights shall flash at a frequency of (2 ± 0.6) Hz.

(4) The optical signals for the escape, fire and evacuation alarms shall be codified.

(5) For plant-internal purposes (e.g., for signaling operational procedures) any lamp combinations with continuous (non-flashing) lights are admissible.

(6) An acoustic attention signal shall bring attention to the actuated optical alarm; this attention signal shall be an intermittent tone with a duration of at least ten seconds. The all-clear signal shall be issued as a continuous tone. The sound level of these acoustic signals shall clearly exceed the listening threshold during specified normal operation.

3.3 Staff-Paging Systems

3.3.1 Requirements for the staff-paging system

(1) Two independent and different staff-paging systems shall be provided for in the nuclear power plant such that the personnel responsible for the management and surveillance of the nuclear power plant operation can be reached on the nuclear power plant site at all times.

(2) It is permissible to design the staff-paging systems such that other persons can also be paged.

(3) It shall be possible to operate the staff-paging systems from the alarm posts. If additional operating locations are provided, the alarm posts shall have upper priority.

3.3.2 Design and construction of the staff-paging systems

(1) The staff-paging systems shall be designed such that a random failure of one component cannot cause the simultaneous failure of both systems.

(2) The stationary components of the staff-paging systems required for signal transfer shall be powered from uninterruptible

emergency power facilities. The power supplies of the portable units shall be periodically serviced or exchanged.

(3) The range of reception of the staff paging systems shall extend to the entire nuclear power plant site both inside and outside of the buildings.

(4) One of the staff-paging systems shall be one of the following items a) or b) and the other a different system of the items a) through d):

a) Wireless staff-paging system
The wireless staff-paging system shall be equipped with one receiver for each person to be reached.

b) Optical staff-paging system
In the case of an optical staff-paging system, the paging procedure shall be announced by an acoustic attention signal which, in case of an optical alarm system, must be uniquely different from the acoustic attention signal of this optical alarm system.

c) Public-address system
If a public-address system is used as staff-paging system, the broadcast range shall cover the frequency range from at least 350 Hz to 3 kHz. Provided this requirement is met, the acoustic alarm system may be used as a staff-paging system.

d) Handheld radiophone sets (walkie-talkies).

3.4 Voice Communication Systems

3.4.1 General requirements

The design of the voice communication systems shall be such that the necessary communication during design basis accidents, external events and other accidents is ensured with at least one of the voice communication systems.

3.4.2 Telephone Systems

3.4.2.1 Telecommunication system (TC system)

(1) For the purpose of general communication, a telecommunication system shall be installed with the necessary number of extensions.

(2) For the information of control room personnel about a hazard condition in the respective nuclear power plant unit, one extension phone in the control room answering to the emergency telephone number shall be available at all times and shall not be accessible from the external telecommunication network.

(3) Each of the extension phones shall be marked with the emergency telephone number specific to the power plant unit.

(4) Each of the extension phones shall be marked with its exact location, unless the location is automatically indicated in the control room.

(5) When using IP telephone systems, it shall be ensured that the voice communication is not inadmissibly impaired by data communications.

3.4.2.2 Supervisory intercom system

(1) For the direct communication between the control room and the emergency control station and with safety-related local control stations and facilities of the nuclear power plant, a hard-wired plant-unit specific supervisory intercom system shall be installed.

N o t e :

Safety-related local control stations and facilities of the nuclear power plant are, e.g., personnel and material locks (lock interiors and control panels), diesel facility, control panel of the refueling machine and lift cages in the controlled area. Also included may be the transducer, switchgear and electronic compartments.

(2) A communication between the control rooms of a multi-unit nuclear power plant shall be possible with the supervisory intercom systems. However, the supervisory intercom system shall be available for simultaneously conducting an internal telephone conversation within the particular nuclear power plant unit.

(3) The supervisory intercom system shall be designed to allow making conference calls from the control rooms.

(4) The supervisory intercom system may be expanded for operational purposes.

(5) The supervisory intercom system shall be independent of the telecommunication system regarding function and equipment and shall use a separate wire network.

(6) The supervisory telephone system shall be powered from an uninterruptible emergency power facility.

(7) The functional capability of the intercom central and the interconnections to the extensions shall normally be monitored. Technical faults shall normally be acoustically and optically signaled as a group alarm in the control room.

3.4.2 Radiophone devices

As supplement to the hard-wired telephone systems, it is admissible to use radiophone devices for communication.

4 Means for Communicating from the Nuclear Power Plant to the Outside

4.1 General Requirements

(1) Means for communicating from the nuclear power plants to the outside are required as specified under Sections 4.2 through 4.6.

(2) Type and extent of the projected communication means shall be specified.

(3) The design and construction of the communication means specified under Sections 4.2, 4.3, 4.6.1 and 4.6.2 shall ensure that the communication necessary in case of design-basis accidents, external events and other accidents is possible with at least one of the communication means.

4.2 Connection to External Telecommunication Networks

(1) A main telecommunication connection shall be installed in the control room and in the remote shutdown station of each nuclear power plant unit.

N o t e :

When installing these connections in the control room and in the remote shutdown station care shall be taken that separate lines are used.

(2) The telephone numbers of these connections may not be made public.

4.3 Connection to Private Telecommunication Networks

The telecommunication facility of the nuclear power plant may be connected with other private telecommunication networks (e.g., the telecommunication network of the operator of the high-voltage grid).

4.4 Connection to Stand-By Personnel

(1) It shall be possible to reach the stand-by personnel via two independent communication means.

(2) If automatic calling facilities (autodialers) are used then the notified person shall be required to confirm the call.

4.5 Connection to Radiation Measurement Troops

It shall be possible to contact the radiation measurement troops deployed outside of the nuclear power plant site at all times from the control room and from the remote shutdown station. The reception range shall comply with the requirements of disaster control.

4.6 Interconnection with Public Authorities and Service Organizations

4.6.1 Interconnection with the fire department

(1) It shall be possible to directly alert the proper fire department or the regional (fire) control center.

(2) A direct alerting of the proper fire department specified under para. (1) may be dispensed with if the direct alerting of the proper fire department is ensured by the continuously staffed police station specified under Section 4.6.2.

4.6.2 Interconnection with the police station

(1) It shall be possible to reliably contact a continuously staffed police station via two independent voice communication lines.

(2) The functional availability of both voice communication lines shall be monitored or shall at least be checked once a day. At least one of the voice communication lines shall be continuously monitored.

Note:

In case the interconnection to the police station is mutually used by the plant security center, the control room and other control stations, the additional plant security requirements shall be taken into consideration.

5 Design Requirements

5.1 Ambient Conditions

(1) The ambient conditions for the components shall be specified regarding the location of installation and the conditions in case of demand.

(2) The design of the components shall correspond to these ambient conditions.

5.2 Component Quality

(1) Only such components shall be used that are suited for the specific task and the operating conditions.

(2) It is basically required to show that the components are service-proved, or suitability tested, or that their reliability has been demonstrated. If the components used are series-produced items that meet the corresponding requirements of the present safety standard, none of the certifications above are required for these components.

5.3 Electromagnetic Compatibility

(1) It shall be demonstrated for any stationary and mobile radio-transmitter equipment deployed that they will not inadmissibly affect the equipment of the safety system nor other safety-related equipment.

(2) The nuclear power plant specific limitations regarding the use of stationary and mobile radio-transmitter equipment shall be observed.

Notes:

(1) The nuclear power plant specific limitations concern, e.g., regions of required radio silence and limitations of the maxim admissible field strength.

(2) The transmitted energy of radio transmitters is often specified in units of the effective radiation energy relative to a half-wave dipole. Therefore, the field strength under far-field conditions may be roughly estimated by applying the dipole equation (cf. Appendix E of DIN EN 61000-4-3). Reflecting and absorbing objects in the vicinity may influence the field.

5.4 Computer-Based Communication Means

In the case of computer-based communication means, measures in accordance with their safety-related significance shall be specified regarding the protection of confidentiality, of integrity and availability.

6 Tests, Certifications and Repairs

6.1 Design Review

Documents of the communication means shall be presented for design review showing that the requirements specified in the present safety standard are met.

6.2 Acceptance and Functional Tests

(1) Acceptance and functional tests shall be carried out on the communication means after their installation and after any modifications.

(2) Type, extent, testing methods and the testers shall be specified for the tests.

(3) The tests performed shall be documented in a test report.

6.3 Inservice Inspections

(1) The perfect functioning of the communication means shall be demonstrated in periodic inservice inspections.

(2) Type, extent, testing methods, testing interval and the testers shall be specified for the inspections. The testing interval shall normally not exceed one year.

(3) A functional test is not required in those cases where communication means are continuously in operation and are, thereby, subjected to a quasi-continuous functional test.

(4) The performed inservice inspections shall be documented as specified in safety standard KTA 1202, Sec. 3.5.

6.4 Repairs

(1) Failed components of the communication means shall be repaired without delay.

(2) After performing the repair, proper functioning of the respective communication means shall be demonstrated by a test.

Alarm	*Acoustic Alarm Signal*	*Optical Attention Signal*
Escape Alarm	howl tone about 1200 Hz about 500 Hz	Additional optical attention signals as specified under Section 3.2.4.1, para. (3)
Fire Alarm	stepped frequency change about 1075 Hz about 925 Hz	
Evacuation Alarm	short-tone sequence about 500 Hz 0 Hz	
All-Clear Signal	continuous tone about 500 Hz 0 Hz	

Table 3-1: Design examples for acoustic alarm signals of the acoustic alarm facility

Appendix A

Regulations Referred to in the Present Safety Standard

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

AtG		Act on the peaceful utilization of atomic energy and the protection against its hazards (Atomic Energy Act – AtG) of December 23, 1959, revised version of July 15, 1985 (BGBl. I, p. 1565), most recently changed by Article 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 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 of November 22, 2012, revised version of March 3, 2015 (BAnz AT of March 30, 2015 B2)
SiAnf-Interpretations	(2015-03)	Interpretations of the safety requirements for nuclear power plants of November 22, 2012, revised version of March 3, 2015 (BAnz AT of March 30, 2015 B3)
KTA 1202	(2017-11)	Requirements for the testing manual
KTA 1401	(2017-11)	General requirements regarding quality assurance
KTA 1404	(2013-11)	General requirements regarding quality assurance
KTA 2101.1	(2015-11)	Fire protection in nuclear power plants; Part 1: Basic requirements
KTA 2101.2	(2015-11)	Fire protection in nuclear power plants; Part 2: Fire protection of structural components
KTA 2101.3	(2015-11)	Fire protection in nuclear power plants; Part 3: Fire protection of mechanical and electrical plant components
KTA 2201.4	(2012-11)	Design of nuclear power plants against seismic events; Part 4: Components
KTA 2206	(2009-11)	Design of nuclear power plants against damaging effects from lightning
KTA 3502	(2012-11)	Accident measuring systems
KTA 3904	(2017-11)	Control room, remote shutdown station and local control stations in nuclear power plants
DIN EN 61000-4-3 (VDE 0847-4-3)	(2011-04)	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3:2006 + A1:2007 + A2:2010); German version EN 61000-4-3:2006 + A1:2008 + A2:2010