

Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 1301.2 (11/2014)

**Radiation Protection Considerations for Plant Personnel
in the Design and Operation of Nuclear Power Plants
Part 2: Operation**

(Berücksichtigung des Strahlenschutzes der Arbeitskräfte
bei Auslegung und Betrieb von Kernkraftwerken
Teil 2: Betrieb)

The previous version of this safety standard
was issued in 1982-06, 1989-06 and 2008-11

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

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Comments by the Editor:

Taking into account the meaning and usage of auxiliary verbs in the German language, in this translation the following agreements are effective:

shall	indicates a mandatory requirement,
shall basically	is used in the case of mandatory requirements to which specific exceptions (and only those!) are permitted. It is a requirement of the KTA that these exceptions - other than those in the case of shall normally - are specified in the text of the safety standard,
shall normally	indicates a requirement to which exceptions are allowed. However, exceptions used shall be substantiated during the licensing procedure,
should	indicates a recommendation or an example of good practice,
may	indicates an acceptable or permissible method within the scope of this safety standard.

Basic Principles

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

(2) The safety standards of the series KTA 1301 specify protective-goal-oriented requirements for the design of nuclear power plants and to the administrative and technical measures that are considered to be necessarily implemented for the protection of personnel employed in the nuclear power plant from any radiation exposure, and they specify requirements for the workplace and work environment design and for the organization of the work procedure. In this regard, special attention is paid to Sec. 6 StrlSchV.

The safety standard series KTA 1301 consists of two parts:

Part 1: Design

Part 2: Operation

1 Scope

This safety standard applies to the specification of radiation protection measures with respect to the personnel working in the nuclear power plant. The safety standard deals with the measures required for work activities performed during specified normal operation of the nuclear power plant and during modification tasks and also deals with the planning of measures in regard to design basis accidents and severe accidents (cf. definitions in Sec. 3 StrlSchV).

2 Definitions

Radiation protection personnel

Radiation protection personnel comprises those persons commissioned to perform radiation protection tasks by order and under direction of the radiation protection commissioner.

3 Radiation Protection Organization

3.1 Organizational Structure

(1) The organizational structure within the nuclear power plant as implemented by the radiation protection supervisor shall normally consider

- a) the radiation protection commissioner of the nuclear power plant and his representatives,
- b) if necessary, any further radiation protection commissioners with a limited range of authority,
- c) the radiation protection personnel, including contract personnel permanently or temporarily commissioned with radiation protection tasks, who are involved in planning, implementing, performing or supervising measures for the protection of the personnel from the effects of ionizing radiation.

(2) The tasks, plant-internal ranges of authorization and competence of the radiation protection commissioners and their representatives in accordance with Paragraph 1, items a) and b) shall be specified in writing and such that they are mutually distinguished from each other.

(3) The radiation protection commissioner of the nuclear power plant shall have such a position within the plant organization that he is at all times permitted to order the interruption of any work activities if this is required for the protection of personnel from the dangers of ionizing radiation, provided however, no serious safety-related reasons stand against this interruption.

(4) The radiation protection commissioner, his representatives and the radiation protection personnel shall be positioned within the plant organization such that they are basically independent of production and maintenance. It is permitted to appoint, e.g., the shift supervisor as a radiation protection commissioner with a limited range of authority in order to, especially, implement and perform the measures in accordance with Sec. 51 StrlSchV.

3.2 Tasks and Authorizations

3.2.1 Radiation protection supervisor

(1) The radiation protection supervisor shall attend to his tasks and responsibility in full accordance with the Radiation Protection Ordinance (StrlSchV). He shall establish suitable protection measures which ensure that the radiation protection principles and basic duties in accordance with Secs. 5 and 6 StrlSchV and the regulations specified in Sec. 33 StrlSchV are observed.

(2) The radiation protection supervisor shall issue corresponding directives by which the radiation protection commissioner is ensured a direct reporting access to himself and to the director of the power plant.

(3) The radiation protection supervisor shall ensure that the director of the power plant informs the radiation protection commissioner of any planned changes to the construction or operation of the plant as well as of any planned maintenance measures and that his information is performed sufficiently ahead in time that the concerns of radiation protection can be taken into consideration.

(4) The radiation protection supervisor shall ensure that sufficient financial means and suitable personnel in sufficient number are available for radiation protection.

(5) The radiation protection supervisor shall ensure that the procedures regarding radiation protection (e.g., education and training, procedural organization, measures for preventing inadvertent dispersion of radioactive substances) can be continually improved by applying the method of cyclical management.

Note:

Requirements regarding 'Management systems for the operation of nuclear facilities' are being specified in the safety standard project KTA 1402.

3.2.2 Radiation protection commissioner

(1) The radiation protection commissioner shall attend to his duties and responsibilities within the plant-internal range of authority in accordance with the Radiation Protection Ordinance (StrlSchV) that was assigned to him in writing by the radiation protection supervisor.

(2) It is permissible that the radiation protection commissioner assigns qualified persons with the performance of tasks that arise from his duties in accordance with Sec. 33, para. 2 StrlSchV. It is up to him to decide what level of radiation protection knowledge – S1, S2 or S3 in accordance with the Guideline Necessary Knowledge – and what specific knowledge and capabilities with respect to the individual task are required of the individual person assigned by him to perform the individual task.

(3) In regard to Sec. 32, para. 2 StrlSchV, the radiation protection commissioner shall, without delay, report any deficiencies to the radiation protection supervisor that are detrimental to radiation protection and that cannot be remedied by himself within his plant-internal range of authority.

(4) The radiation protection commissioner shall prepare and update the radiation protection regulation in accordance with safety standard KTA 1201. He shall cooperate in the preparation of the operating manual wherever aspects of radiation protection are possibly concerned, e.g., the maintenance regulation and alarm regulation.

(5) The radiation protection commissioner shall prepare the instructions that are necessary to ensure radiation protection.

(6) The radiation protection commissioner shall ensure that a radiation protection documentation as specified under Section 15 is prepared and properly updated.

3.2.3 Radiation protection commissioners with a limited range of authority

Every radiation protection commissioner with a limited range of authority shall attend to his duties and responsibilities within the plant-internal range of authority in accordance with the Radiation Protection Ordinance (StrlSchV) that was assigned to him in writing by the radiation protection supervisor.

3.3 Schematic of the Radiation Protection Organization

A schematic of the radiation protection organization shall present the radiation protection supervisor and his duties and, in accordance with Sec. 6.5 of safety standard KTA 1201, shall list all radiation protection commissioners appointed in accordance with Sec. 31, para. 2 StrlSchV and the duties and responsibilities delegated to them and their plant-internal range of authority. Their cooperation with the specialists for work safety (cf. Sec. 32, para. 4 StrlSchV) shall be described.

4 Instructions and Operating Regulations

(1) The radiation protection supervisor shall ensure by proper instructions that written instructions are issued regarding the duties that must be fulfilled in accordance with the Radiation Protection Ordinance (StrlSchV) in the nuclear power plant.

(2) The radiation protection commissioner shall prepare the instructions that are necessary to ensure radiation protection. In this regard, all requirements resulting from the operation and the structural plant condition, the requirements of the Radiation Protection Ordinance (StrlSchV) and the guidelines and KTA safety standards as well as the recommendations of the Radiological Protection Commission (SSK) shall be taken into consideration.

(3) The system of instructions pertaining to radiation protection shall normally comprise the following elements:

- a) radiation protection instructions in accordance with Sec. 34 StrlSchV (radiation protection regulation and if necessary parts of other operating regulations),
- b) radiation protection instructions ensuring, in particular, the correct implementation of administrative and physical radiation protection measures and which are directed, generally, to the personnel active in the controlled areas,
- c) technical and work instructions, directed exclusively to the radiation protection personnel, and
- d) instructions for emergency situations.

(4) The operating regulations and instructions pertaining to radiation protection issued in accordance with the requirements specified in StrlSchV, IWRS II and safety standard KTA 1201 as well as plant-internal requirements shall be reviewed by the

radiation protection commissioner in regular intervals (e.g., annually) and on the occasion of certain events (e.g., engineering changes of the power plant) to ascertain their actuality and continued applicability and, if necessary, to implement changes.

(5) The radiation protection instructions as specified under Paragraph 3, items a) and b) shall be released by the radiation protection commissioner of the nuclear power plant and shall be put into force by the radiation protection supervisor or by a person commissioned by him for this task.

(6) Technical and work instructions as specified under Paragraph 3, item c) shall be put into force by the radiation protection commissioner or by a person commissioned by him for this task.

(7) The instructions for emergency situations as specified under Paragraph 3, item d) shall be incorporated by the radiation protection commissioner to the extent necessary into the emergency manuals or other manuals intended for use during emergencies.

(8) The instructions pertaining to radiation protection shall be understandable to anyone whose behavior shall normally comply with the instructions or who shall normally follow these instructions during his tasks.

(9) A quality assurance procedure shall be applied to the preparation, modification and withdrawal of instructions.

5 Personnel Qualification

Specific guidelines of the Federal Minister for Environment, Nature Conservation and Nuclear Safety (BMU) shall be applied in regard to the requisite knowledge and know-how in radiation protection in accordance with Sec. 30 StrlSchV to the personnel specified under Section 3, and shall be applied in regard to maintaining this qualification. These guidelines are

- a) GL Technical Qualification of RPC – for the radiation protection commissioner, his representatives and other radiation protection commissioners,
- b) GL Required Qualification – for the radiation protection personnel including third party personnel permanently or temporarily assigned to radiation protection tasks, and
- c) GL Proof of Technical Qualification – for persons in responsible positions.

Note:

Furthermore, take note of the Guideline 'Requirements for maintaining the technical qualification of responsible nuclear power plant personnel (other than the responsible shift personnel)'.

6 Measures for Maintaining Radiation Protection Principles

(1) The radiation protection commissioner shall plan and specify the required radiation protection measures for the work tasks in radiation protection areas as required in regard to the protective goals mentioned in Section Fundamentals.

(2) The radiation protection personal shall perform continuous or random checks to ensure that the specified radiation protection measures are observed. This concerns, especially, the carrying of special dosimeters, working behind designated shielding walls, onsite stay restrictions, use of personal protective gear, carrying of respirators, and observing the specified minimum distance and work procedure during work activities in controlled areas.

(3) These checks shall be performed such that the radiation exposure of the persons carrying out the checks remains as low as possible.

7 Establishing and Monitoring the Radiation Protection Areas

7.1 General Requirements

(1) To achieve the protective goals mentioned in Section Fundamentals it is required to delimit the radiation protection areas with respect to each other as specified under Section 7.2. These areas may be permanent or may be (temporarily) installed depending on the operating condition of the plant.

(2) The radiation protection commissioner shall specify the boundaries of the radiation protection areas and the required radiation protection measures.

(3) The radiation protection commissioner shall ensure that the boundaries of the radiation protection areas are regularly monitored in regard to the maximum permitted contamination values in accordance with Sec. 44 StrlSchV. Structural, technical and administrative measures shall be provided in order to prevent any inadvertent dispersion of radioactive substances from the radiation protection areas. It shall, furthermore, be ensured that any inadvertent dispersion of radioactive substances above the limit values specified for contamination and the overall radioactivity in accordance with criteria S.1.4.1 and E.1.4.1 AtSMV are reliably detected.

(4) The radiation protection commissioner shall establish measures for the protection of the unborn. These include:

- a) analysis of the work places for women in regard to the risk of incorporations,
- b) specification of working conditions for pregnant and breast-feeding women,
- c) general instructions, and
- d) ensuring that the limit values in accordance with Sec. 55, para. 4 StrlSchV are not exceeded.

(5) The radiation protection commissioner shall ensure that, in regard to persons under the age of 18 years, the limit values in accordance with Sec. 55, para. 3 StrlSchV are not exceeded.

7.2 Radiation Protection Areas

7.2.1 Supervised areas

The radiation protection commissioner shall specify the monitoring measures required in accordance with Secs. 36 and 37 StrlSchV for supervised areas and shall ensure that these measures are observed and that the boundaries of the supervised areas are newly specified in case of changed conditions.

7.2.2 Controlled areas

(1) Certain controlled areas in the nuclear power plant shall be structurally enclosed as "Permanent Controlled Areas" and the access point to these areas shall be clearly and permanently marked in accordance with Secs. 36, para. 2 and 68 StrlSchV.

Temporary controlled areas shall, as required, be established outside of the permanent controlled areas.

Note:

On the basis of a regular presence of occupationally exposed personnel working there, controlled areas are, generally, established wherever the local dose rate lastingly exceeds 3 $\mu\text{Sv/h}$.

(2) In intervals to be specified by the radiation protection commissioner, the boundaries of the controlled areas shall be checked by dose-rate measurements and, if necessary, new boundaries shall be established. With these measurements operating conditions shall be taken into consideration that could lead to dose-rate changes at the boundaries of the controlled areas.

(3) The radiation protection commissioner shall ensure that no other persons will enter the controlled areas than those that meet the requirements in accordance with Secs. 37, 38, 45, and 55 through 60 StrlSchV.

(4) Entering and leaving the controlled areas shall basically be only possible under the surveillance or control of radiation protection personnel or under automatically executed controls. Exceptions (e.g., in case of alarms) shall be specified in the plant regulations (part 1 of the operating manual in accordance with safety standard KTA 1201).

(5) The radiation protection commissioner shall ensure that all persons who have been allowed entry into controlled areas will, in accordance with Sec. 38 StrlSchV, receive a safety briefing before entering for the first time. These briefings shall be repeated in yearly intervals.

(6) The briefings specified under Paragraph 5 shall stress the individual's self-responsibility and shall cover the subject matters in accordance with Sec. 38 StrlSchV and those subject matters pertaining to the plant-internal radiation protection. These comprise, in particular,

- a) those parts of the radiation protection regulation (as part of the plant regulations in accordance with safety standard KTA 1201) that are essential to plant operating procedures,
- b) information regarding special conditions prevailing at the time of instruction (e.g., operating conditions),
- c) the importance of reporting any therapeutic or diagnostic intake of radioactive substances to the radiation protection personnel prior to commencement of work activities in controlled areas, and
- d) the importance of immediately reporting to the radiation protection commissioner if specified intervention limit values of the daily personal dose (daily dose limit guide value) have been exceeded.

(7) The safety briefings specified under Paragraph 5 shall be documented in accordance with Sec. 38, para. 4 StrlSchV stating the person involved, the contents and date of the briefing. These documents shall be included in the radiation protection documentation as specified under Section 15.

(8) Above and beyond the instructions in accordance with Sec. 38 StrlSchV, and in preparation of work activities to be performed in controlled areas, the radiation protection personnel shall, if necessary, instruct the persons concerned about any further radiation protection measures they must observe during these activities (e.g., dose limits, special monitoring equipment, protective clothing, paying attention to contamination zones, preventing inadvertent dispersion of radioactive substances, experience from previous activities).

(9) The radiation protection commissioner shall ensure that the agreements reached with subcontractors regarding the plant-specific radiation protection of the contract personnel during their deployment are adhered to.

(10) The radiation protection commissioner shall ensure that those occupationally exposed personnel deployed in controlled areas within the framework of a license under Sec. 15 StrlSchV will take up their activity only if they are in possession of a correctly filled out radiation pass that has been registered with the proper authorities.

(11) The radiation protection commissioner shall ensure that contract personnel will take up their activity in the assigned controlled area only if those records with respect to radiation exposure that were established outside of the scope of the Radiation Protection Ordinance (StrlSchV) and that are presented in place of a radiation pass contain data that is comparable to those in a radiation pass and contain, at least, data on the personal dose level accumulated in the running year and on the

location and point in time of the most recent medical examination. These records shall be presented to the proper authority responsible for approving radiation passes.

7.2.3 Exclusion areas

(1) Besides having to be marked as exclusion areas, the access points of these areas shall also be permanently secured against uncontrolled access by, e.g., installing chains, locking doors, or putting up barriers.

Note:

The markings and boundaries of an exclusion area are usually placed at locations where the local dose rate is considerably lower than 3 mSv/h.

(2) In preparation of maintenance tasks and of the required specification of a routine or special radiation protection procedure in accordance with IWRs II, the radiation protection personnel shall check and, if necessary, reposition the boundaries of the exclusion areas. In regard to measuring the local dose rate in exclusion areas, the requirements in accordance with safety standard KTA 1501 shall be applied.

(3) The markings of the boundary of an exclusion area shall specify – if necessary, dependent on the plant operating condition – the maximum possible local dose rate to be expected within the exclusion area at locations accessible without technical aid. The markings and, if applicable, securing measures of the exclusion area may only be removed by the radiation protection personnel and only if the conditions for the respective exclusion area no longer apply.

(4) The radiation protection commissioner shall ensure that access to an exclusion area is allowed only within the framework of specified operational procedures or for urgently required operational reasons. An exclusion area may be entered only under the supervision of and, if necessary in the company of, the radiation protection commissioner or a person commissioned by him for this supervising task. Except for well-founded exceptional cases, no work activities may be performed in exclusion areas by other than occupationally exposed persons of Category A.

(5) Above and beyond the instructions in accordance with Sec. 38 StrlSchV, the radiation protection personnel shall, if necessary, instruct the persons concerned in preparation of their work activities in exclusion areas about any further radiation protection measures they must observe during these activities (e.g., dose limits, special monitoring equipment, protective clothing, paying attention to contamination zones).

8 Measures in Case of Contamination

8.1 Contamination Zones and Decontamination

(1) The radiation protection commissioner shall specify the limit value from which on any loose (non-adhering) surface contamination must be removed. In the case of remaining residual contamination, the surfaces concerned shall be marked and the parts concerned shall be marked and stored in such a way that inadvertent dispersion of radioactive substances is prevented.

(2) To avoid any dispersion of radioactive substances from zones where the specified level of surface contamination in accordance with Sec. 44, para. 2 StrlSchV is exceeded, these zones shall be enclosed without delay and shall be marked with the warning sign WS 141 "Careful! Contamination" in accordance with DIN 25430 and the corresponding contamination value shall be noted on the sign.

(3) Any tightly adhering surface contamination shall only be removed if an overall reduction of the collective dose can be expected taking the radiation exposure during decontamination into account. In this regard, all working steps shall be included

and, in the case of repetitive work activities, their frequency considered.

8.2 Contamination During Work Activities

If a contamination cannot be avoided during work activities in controlled areas, contamination zones shall already be established prior to the start of the work activities and suitable protective measures provided. These may be:

- a) provision of the specified suitable personal protective gear and provision of a changing cubicle at the access point to the zone,
- b) provision of tents with a filtered exhaust,
- c) regular monitoring of the zone areas for contamination,
- d) cleaning in sensibly specified cleaning cycles during the running work activities to reduce the open contamination under consideration of the dose of the cleaning personnel,
- e) monitoring for aerosol-bound radioactive substances in the case of a volatile (in particular, dry) contamination.

Any contamination in accessible areas shall be immediately removed, at the latest after completion of the work activities.

9 Physical Radiation Protection Monitoring

9.1 Monitoring the Individual and Collective Dose

(1) In accordance with Sec. 40, para. 1 StrlSchV, the body doses shall be determined in accordance with Sec. 40, para. 1 StrlSchV for all persons that dwell in a controlled area. In this regard, Parts 1 and 2 of GL Physical Radiation Protection Monitoring shall be taken into consideration.

(2) For the surveillance that the personal dose limit values in accordance with Secs. 55 and 56 StrlSchV are not exceeded and to avoid any unanticipated radiation exposure, the radiation protection commissioner shall specify intervention limit values for the daily personal dose (daily dose limit guide values) and, also, dose rate alarm thresholds as follows:

- a) The daily dose limit guide value shall be specified under consideration of the plant-specific conditions and shall be sufficiently dimensioned to be useable as planning basis for the deployment of personnel for the work activities inside the controlled area. Whenever the daily dose limit guide value is exceeded this shall be reported to the radiation commissioner. He shall then assure that the cause of exceeding is determined and that measures to avoid any repetition are taken (e.g., specification of additional radiation protection measures, changes to the work procedure).

Note:

Typical daily dose limit guide values range from 0.5 mSv/d to 2 mSv/d.

- b) The dose rate alarm thresholds shall be specified such that an alarm is sounded as soon as an area is entered where the dose rate is larger than the one anticipated for the planned work activity. The dose rate alarm thresholds shall be adapted to the different work places for which they are specified.

(3) In context of specifying daily dose limit guide values and dose rate alarm thresholds, the radiation protection commissioner shall also specify the further procedures to follow whenever these limit values are exceeded. Rules of conduct for the case that daily dose limit guide values and dose rate alarm thresholds are exceeded shall be established for the monitored personnel and shall be included in the radiation protection instructions.

(4) The personal dose values shall be recorded with respect to the specific task, and the collective doses shall be determined for individual tasks (e.g., non-destructive examination of the reactor pressure vessel) or for general work activities (e.g., refueling in conjunction with the removal and replacement of the reactor pressure vessel closure head). In this regard, the preparatory measures related to the corresponding task (e.g., assembling and disassembling housings and mobile shields, decontamination of systems and components) shall be taken into account. In accordance with IWRS II, the method of recording shall ensure that any task with personal dose values larger than 6 mSv or a collective dose larger than 25 mSv is promptly recognized.

(5) For work activities in a strongly inhomogeneous radiation field, if it must be anticipated that the organ-specific dose of the eye lens will exceed a value of 45 mSv per year, or that the organ-specific dose of one of the body parts in accordance with Sec. 55, para. 2, item 2 StrlSchV (hands, forearms, feet, ankles) will exceed a value of 150 mSv per year, then the personal surface dose $H_p(0.07)$ shall be monitored by an additional dosimeter in the vicinity of the eye lens or, relevant to skin exposure, on the most highly exposed body part.

(6) In the case that, due to increased concentration of radioactive substances in the air, or due to insufficient personal protective clothing or due to skin injuries in contaminated areas, if it must be suspected that the effective dose in the calendar year will or could exceed 1 mSv or that, due to internal contamination, the reporting threshold specified by the proper authority will or could be exceeded, then limit values specific to the person involved shall be determined in accordance with Part 2 of GL Physical Radiation Protection Monitoring.

(7) In accordance with Sec. 42 StrlSchV, any radiation exposure shall be documented, and these documents shall be incorporated in the radiation protection documentation specified in Section 15.

9.2 Monitoring of Person Contamination

(1) In order to prevent radioactive substances from entering the body, no person shall go into areas in which the surface contaminations exceed the limit values in accordance with Sec. 44, para. 2 StrlSchV without corresponding protective clothing.

(2) Persons leaving any controlled areas where unsealed radioactive substances are located shall basically be subjected to measurements with whole-body monitors. In well-founded exceptional cases (e.g., seldom used exit points), the monitoring may be performed with other contamination measurement equipment (e.g., hand-foot-clothing monitors, mobile contamination monitors). All this equipment shall be suited to detect the plant-specific mixture of radionuclides. It shall be ensured by suitable devices that the person stays within a smallest possible distance from the detectors. The surface radioactivity limit values shall be adjusted in accordance with Appendix III, Table 1, Column 4 StrlSchV and with the SSK Report, Vol. 34.

Note:

Additional requirements regarding contamination measurement equipment and monitors are specified in DIN EN 60325 and DIN EN 61098.

(3) If a person contamination is determined appropriate steps shall be immediately taken to prevent further radiation exposure of the skin or to prevent an incorporation. The corresponding procedure shall be specified by the radiation protection commissioner in a special written instruction. These instructions shall be based on, the SSK Publication, Vol. 18. The radiation protection commissioner shall ensure that only expert personnel in accordance with Sec. 44, para. 4 StrlSchV is put in charge of the decontamination.

(4) An adhering skin contamination below a level of 10 Bq/cm² may remain after the decontamination. The person concerned shall be allowed to leave the controlled area without applying further measures. Each individual case shall be documented by recording the name of the person, the body part concerned and the level of contamination.

(5) In case of an adhering skin contamination exceeding a level of 10 Bq/cm² or if a wound contamination is suspected, a physician competent in radiation protection (e.g. company physician) or a regional radiation protection center shall be called in for an assessment of the situation. The radiation protection commissioner shall give his support to the physician in the investigation and assessment of the radiation exposure received. The requirements regarding continued work activities shall be specified by the radiation protection commissioner and the physician competent in radiation protection. In case of contract personnel, the third party's radiation protection commissioner in charge shall be informed.

Note 1:

A contamination by a nuclide mixture specific to nuclear power plants of 1 Bq/cm² on the outer layer (horny layer) of the skin will cause a dose rate of up to 2 µSv/h in the basal layer

Note 2:

In Germany, the regional radiation protection centers are run by the Accident Prevention Associations and are located at eleven different locations.

10 Radiation Measurements

(1) In regular time intervals, the radiation protection personal shall measure and evaluate the local dose rate at accessible locations in controlled areas, shall monitor the concentration of radioactivity in the room atmosphere and shall perform tests for loose surface contamination (cf. Sec. 44 StrlSchV in connection with Appendix III, Table 1 StrlSchV). If necessary, the regular measurements shall be supplemented by additional measurements to the extent as required by the planned work activity. These measurements and measurement results shall be documented and these documents incorporated in the radiation protection documentation specified in Section 15. Exploratory measurements that, e.g., serve to check the surface contamination within the framework of decontamination activities are exempted from this requirement to be documented.

(2) At the entrances to accessible rooms and at characteristic places on systems and components to be specified by the radiation protection commissioner, the local dose rates shall be posted on legend plates together with the date of the most recently performed measurement. These legend plates shall be updated in regular intervals, however, always before major maintenance and modification tasks.

11 Planning and Preparation of Work Activities in Controlled Areas

(1) The radiation protection commissioner shall be consulted in the technical clarification, planning and preparation of work activities (maintenance measures, modifications, material and trash removal, disassembly tasks) in controlled areas. The consultation shall be initiated early enough for dose reducing measures - such as optimization of work procedures and schedules, training measures, decontamination measures, use of shielding, release switching, interference from parallel work activities, requirements regarding the prevention of contamination, incorporation and inadvertent dispersion of radioactive substances (Secs. 6, 43 and 44 StrlSchV) - can be taken into consideration or specified already during these phases.

(2) Detailed requirements with respect to Paragraph 1 and to the release, to the execution, to the surveillance and to the documentation of radiation protection and surveillance measures as well as to the feedback of experience are specified in GL IWRS II and GL Maintenance and Modifications.

12 Storage and Handling of Radioactive Substances

The radiation protection commissioner shall specify the radiation protection measures during storage and handling of radioactive substances and shall supervise the proper execution of these measures. In this regard, the requirements for the storage and handling of fuel elements specified in safety standard KTA 3602 and of other radioactive substances specified in safety standard KTA 3604 shall be taken into consideration.

13 Radiation monitoring devices and Auxiliary Radiation Protection Equipment

13.1 Radiation monitoring devices

(1) The radiation protection personnel shall have a sufficient number of radiation monitoring devices in accordance with Sec. 67 StrlSchV at their disposal, and they shall provide these monitors in numbers as specified during preparation of the work activities. Prior tests shall ensure the functionality of the monitors to be deployed. Aside from these functional tests, the radiation monitoring devices shall be calibrated and maintained and shall be subjected to a certified verification if it is required in accordance with Sec. 2 Verification Ordinance. Regular in-service inspections shall be performed on contamination monitoring assemblies and mobile radiation equipment to prove their proper functionality. The in-service inspections shall perform the tests and in the test frequencies as specified in **Table 13-1**. Maintenance and calibration tests shall be performed at least once every year. The verification shall be conducted by the proper Verification authority in two-year intervals unless a calibration interval prolongation was arranged based on a semi-annual check with properly certified test equipment.

(2) The radiation protection commissioner shall initiate the evaluation of the official dosimeters by the proper evaluation organization in time intervals specified by the proper authority or, if it is suspected that a limit value is exceeded, immediately after the event concerned.

(3) The doses determined with non-official personal dosimeters shall be correlated to the persons working in the plant at least once every work-day.

(4) The doses determined with non-official personal dosimeters shall be recorded in correlation to the work activities performed.

(5) Directly readable electronic dosimeters shall be available in sufficient number such that one electronic dosimeter can be correlated to each employee for his access to a controlled area. The electronic dosimeter shall be integrated into the dosimetry system in such a way that the following functions can be performed in regard to the monitoring the individual and collective doses:

- a) signaling an alarm in case the dose limit values specified by the radiation protection commissioner are exceeded and in case the dose limit values in accordance with Secs. 55 and 56 StrlSchV are reached, and
- b) signaling an alarm in case an area with a higher dose rate is entered (e.g., establishing alarm levels that are specific to a group of persons or to a workplace).

(6) The radiation protection personnel shall be provided with a sufficient number of contamination monitors that, under consideration of the (plant-internal) nuclide vector, are suited to monitor compliance with the requirements in accordance with Sec. 44 StrlSchV. In evaluating the suitability of the monitors and measuring procedures, DIN EN 60325, DIN ISO 7503-1, DIN EN 61098, DIN ISO 11929 and the SSK Report, Vol. 34, shall be taken into consideration.

13.2 Auxiliary Radiation Protection Equipment

(1) The radiation protection equipment (cf. Appendix A) that was specified during preparation of the work activities shall be provided on site directly by the radiation protection personnel, or they shall ensure that this equipment is provided on site. This also applies in regard to design-basis and severe accidents.

(2) In regard to the deployment of personal protective gear, BGR 190 shall be taken into consideration.

(3) The radiation protection personnel shall, in particular, ensure,

- a) that the forced-air ventilated protective clothing and the breathing-air supply lines are tested for their functional capability prior to each use,
- b) that shielding material is available in sufficient quantity and is stored and kept in readiness such that it can be transported to the work place with the least possible radiation exposure; that proper equipment for transport and assembly of the shielding material is provided or attached; and that, as far as possible, contamination of these materials is prevented.
- c) that the filters of protective masks are exchanged and that leak tightness tests are regularly performed on these masks. In this regard, the intervals and expiry dates of the filters suggested by the manufacturer shall be observed as a minimum requirement.

Run-ning Num-ber	Test Object	Type of Test	Testing Interval	
			by operating utility	by authorized expert appointed by proper authority
1	Local dose rate monitor for gamma rays	a) functional test	before each use	-
		b) calibration test	semi-annually ¹⁾	annually ²⁾
		c) verification	every two years (Verification Authority) ³⁾	-
2	Local dose rate monitor for beta rays	a) functional test	before each use	-
		b) calibration test	annually	annually
3	Local dose rate monitor for neutrons	a) functional test	before each use	-
		b) calibration test	every two years	every two years
4	Personal electronic dosimeters:			
	for gamma rays	a) functional test	before each use	-
		b) calibration test	every six months ¹⁾	-
		c) verification	every two years (Verification Authority) ³⁾	-
for neutrons, or neutron channel in case of com- bined dosimeters	functional test or con- stancy test	every six months	annually	
5	Mobile contamination monitors for mate- rial surfaces; rideable monitors for floors	a) functional test	before each use	-
		b) calibration test	quarter yearly	annually
6	Evaluation equipment for swab tests	a) functional test	every workday ⁴⁾	-
		b) calibration test	quarter yearly	annually
7	Personal contamination monitors	a) functional test	every workday	-
		b) calibration test	every six months	annually
8	Small-parts monitor for the detection of gamma rays	a) functional test	every workday	-
		b) calibration test	every six months	annually
9	Gas and aerosol monitors	a) functional test	before each use	-
		b) calibration test	every six months	annually
10	Gas and aerosol collection equipment	a) functional test	before each use	-
		b) calibration test	every five years	-
<p>¹⁾ In case a prolongation of the calibration interval is intended.</p> <p>²⁾ In case of non-calibrated monitors.</p> <p>³⁾ Only for monitors that are used to determine personal doses (cf. Verification Ordinance).</p> <p>⁴⁾ In the case of discontinuous use, e.g., campaign-oriented deployment (e.g. fuel element change), "every workday" relates solely to the campaign-oriented time period.</p>				

Table 13-1: Inservice inspections of contamination monitoring assemblies and mobile radiation monitoring devices

14 Planning and Preparation of Radiation Protection Measures for Design-Basis and Severe Accident Situations

(1) The tasks to be performed by the radiation protection personnel required in regard to the preparatory radiation protection in accordance with Secs. 51 and 53 StrlSchV for design-basis and severe accidents (cf. definitions in Sec. 3 StrlSchV) shall be specified in writing, and these writings shall be included in the system of instructions for radiation protection (cf. Section 4, para. 3). These specifications shall also contain particulars on the extent and frequency of emergency drills for the radiation protection personnel.

(2) The planning and preparation of measures shall be oriented such that during the required measures and work activities any unnecessary radiation exposure is avoided. This includes establishing a protection plan for the personnel in regard to design-basis and severe accident situations.

(3) In planning and preparing the measures it shall be taken into consideration that work activities may become necessary in areas of increased radiation. In this regard, the procedural instructions in accordance with Sec. 15 BGV C16 shall be observed.

(4) The planning and preparation of radiation protection measures for design-basis and severe accidents also entails providing suitable auxiliary radiation protection equipment in sufficient number (cf. Section 13.2).

15 Radiation Protection Documentation

(1) Results and findings of radiation protection monitoring during routine measurements, maintenance and modification works as well as measurements in connection with malfunctions and other events in the plant (e.g., leakages, inadvertent dispersion of radioactive substances) shall be documented and these documents stored such that they are accessible for the radiation protection commissioner at all times. Type and extent of these documents shall be specified. The retention periods specified in safety standard KTA 1404 shall be observed.

(2) The radiation protection documentation shall, in particular, comprise the records specified below.

- a) Personal dose values (cf. Sec. 42 StrlSchV),
 - aa) official dose,
 - ab) non-official dose,
 - ac) radiation protection file which shall, at least, contain the data of the individual radiation passes,
- b) Safety briefing specified under Section 7.2.2, para. 7,
- c) Collective doses specified under Section 9.1, para. 4,
- d) Records regarding the work activity related radiation protection measures in accordance with Sec. 5.2 IWRS II,
- e) Records on any incorporations detected,
- f) Records on any person contaminations as specified in Section 9.2, para. 3,

- g) Results of the radiation measurements specified under Section 10 which shall, at least, comprise the following data:
 - ga) measurement location including data of the distance to the dose-relevant radiation source,
 - gb) plant condition,
 - gc) date and time of the measurement,
 - gd) monitoring equipment,
 - ge) measured value with measurement unit (e.g., mSv/h),
 - gf) name and signature of the person performing the measurement.
 - h) Results of the contamination measurements which shall, at least, comprise the following data:
 - ha) measurement location and area size of the contaminated surface,
 - hb) measurement procedure (wipe test or direct measurement), monitoring equipment,
 - hc) measured value with measurement unit (e.g., Bq/cm²), nuclide or nuclide group,
 - hd) date and time of the measurement,
 - he) name and signature of the executing person.
 - i) Results of air-borne radioactivity measurements which shall at least comprise the following data:
 - ia) measurement location,
 - ib) measurement procedure (sampling with its laboratory evaluation, or direct measurement), measurement monitor, air flow rate in case of sampling,
 - ic) measured value with measurement unit (e.g., Bq/cm³), nuclide or nuclide group,
 - id) date and time of the measurement,
 - ie) name and signature of the person performing the measurement.
 - k) Records in accordance with Sec. 42, para. 3 StrlSchV regarding measures taken in case limit values of the surface contamination are exceeded,
 - l) Records of testing the functional capability of the radiation monitoring devices; the functional tests prior to deployment and the tests to be performed each workday are exempted from this requirement.
- (3) Already in the operation phase, the radiological events relevant to a later disassembly of the power plant (e.g., contamination penetration into the concrete structures, long-term effects of fuel element damages on nuclide vectors) shall be separately documented as data relevant to decommissioning such that, if necessary after a phase of secure containment, the required personnel-independent know-how regarding disassembly will continue to be available. In this regard and especially with regard to an electronic data storage, the long-term availability of these data shall be ensured.

Appendix A Required Auxiliary Radiation Protection Equipment

The auxiliary radiation protection equipment shall comprise:

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| <ul style="list-style-type: none"> a) Mobile radiation monitoring devices <ul style="list-style-type: none"> aa) local dose rate monitors for gamma rays, beta particles and neutrons as well as gamma ray dose limit warning devices and gamma ray dose rate limit warning devices, ab) personal dosimeters for gamma rays and neutrons, ac) special dosimeters (e.g., finger ring dosimeters, wireless dosimeters), ad) nuclide-specific monitoring devices, ae) contamination monitors for material surfaces and floors (in regard to floors, rideable contamination monitors with large-area detectors are recommended), af) personnel surface contamination monitors (installed, where required), ag) small-parts monitors for the checking of small parts and tools, ah) wipe-test-sample evaluation devices, ai) equipment for monitoring the radioactivity concentration of aerosol-bound radioactive substances, of gaseous iodine and of noble gases in the local atmosphere, ak) air sampling equipment for determining aerosol-bound radioactive substances, gaseous iodine and noble gases in the local atmosphere, b) Body protection gear <ul style="list-style-type: none"> ba) protective clothing against dry, wet and gaseous contamination, | <ul style="list-style-type: none"> bb) protective masks with filters against aerosol-bound radioactive substances and radioactive iodine, bc) forced-air ventilated protective gear, bd) skin protective paste, be) gloves, bf) shoes, over-shoes, bg) protective goggles. c) Mobile radiation shielding <ul style="list-style-type: none"> ca) shielding bricks (e.g., lead, concrete), cb) lead mats or sheet lead. d) Waste containers (cf. safety standard KTA 2101.3) e) Materials for setting up demarcations, for markings and warning signs f) Protective sheets, plastic bags, tubular foil, foil welding equipment, adhesive tape, material for foil tents, adhesive mats especially for the exit points of contamination areas g) Materials for the decontamination of persons and small parts h) Floor cleaning equipment i) Mobile and stationary forced-air ventilation equipment for work places k) Special communication equipment (e.g., mobile video equipment, digital cameras) l) Communication means (e.g., wireless voice communication) |
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Appendix B

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) of December 23, 1959 (BGBl. I, p. 814) as Amended and Promulgated on July 15, 1985 (BGBl. I, p. 1565), last Amendment by article 5 of the Law dated 28rd August 2013 (BGBl. I, 2013, no. 52, p. 3313)
StrlSchV		Ordinance on the protection from damage by ionizing radiation (Radiation Protection Ordinance - StrlSchV) of July 20, 2001 (BGBl. I, No. 38, p. 1714), most recently changed by Article 5 of the Act of February 24, 2012 (BGBl. I 2012, No. 10)
SiAnf		Safety Requirements for Nuclear Power Plants of November 22, 2012 (BAnz AT of January 24th, 2013)
AtSMV		Ordinance on the nuclear protection officer and on the notification of design-basis and other accidents (Nuclear Protection Officer and Notification Ordinance – AtSMV) of October 14, 1992 (BGBl. I 1992, No. 48) most recently changed by Ordinance of June 8, 2010 (BGBl. I 2002, page 755)
Verification Ordinance		Verification Ordinance of August 12, 1988 (BGBl. I 1988, No. 43, page 1657) with Attachment 23: Radiation Monitors, most recently changed by Ordinance of June 6, 2011 (BGBl. I 2007, page 1035)
GL Proof of Technical Qualification	(2012-05)	Guideline Concerning the Proof of the Technical Qualification of Nuclear Power Plant Personnel of 24 May 2012, 2012 (GMBI. 2012, No.34, page 611)
GL Maintaining of Technical Qualification	(2013-07)	Guideline Concerning the Maintaining of the responsible Technical Qualifications of Nuclear Power Plant Personnel of 17. July 2013, (GMBI. 2013, No.36, page 712)
GL Technical Qualification RBO	(2014-02)	Guideline on the qualification of radiation protection commissioners in nuclear power plants and other facilities for the fission of nuclear fuel, of February 20, 2014 (GMBI. 2014, No. 13, page 289)
GL Maintenance and Modification	(1978-06)	Guideline relating to the procedure for the preparation and implementation of maintenance work and modifications at nuclear power plants, of June 1, 1978 (GMBI 1978, page 342)
GL Physical Radiation protection Monitoring		Guideline on the physical radiation protection monitoring for determining body doses Part 1: Determining body doses in case of external radiation exposure (Secs. 40, 41 and 42 StrlSchV; Secs. 35 X-Ray Ordinance) of December 8, 2003 (GMBI. 2004, No. 22) Part 2: Determining body doses in case of internal radiation exposure (incorporation monitoring) (Secs. 40, 41 and 42 StrlSchV) of January 12, 2007
GL Required Qualification	(2000-11)	Guideline relating to the assurance of the necessary knowledge of the persons otherwise engaged in the operation of nuclear power plants, of November 30, 2000 (GMBI. 2001, No. 8)
GL IWRS II	(2005-01)	Guideline relating to the radiation protection of the personnel during the execution of maintenance, modification, disposal and disassembly tasks in nuclear power plants and nuclear facilities Part 2: Radiation protection measures during operation and during decommissioning of a plant or facility (IWRS II), of January 17, 2005 (GMBI. 2005, No. 13)
SSK Publication, Vol. 18		Publications by the Commission on Radiological Protection (SSK): Vol. 18: Measures to be taken in cases of radioactive contamination of the skin, 1992

BGV C16	(1987-01)	Regulations by the Accident Prevention and Insurance Association: Nuclear power plants, in the version of January 1, 1997
BGR 190	(2011-12)	Standards by the Accident Prevention and Insurance Association: Use of respiratory protective equipment
KTA 1201	(2009-11)	Requirements for the operating manual
KTA 1402	(2012-11)	Integrated Management Systems for the Safe Operation of Nuclear Power Plants
KTA 1404	(2013-11)	Documentation during the construction and operation of nuclear power plants
KTA 1501	(2010-11)	Stationary system for monitoring the local dose rate within nuclear power plants
KTA 2101.3	(2000-12)	Fire Protection in Nuclear Power Plants; Part 3: Mechanical and Electrical Components
KTA 3602	(2003-11)	Storage and handling of fuel assemblies and associated items in nuclear power plants with light water reactors
KTA 3604	(2005-11)	Storage, handling and plant-internal transport of radioactive substances in nuclear power plants (with the exception of fuel assemblies)
DIN ISO 7503-1	(1990-07)	Evaluation of surface contamination; beta-emitters (maximum beta energy greater than 0,15 MeV) and alpha-emitters
DIN 25430	(2012-07)	Safety marking in radiation protection
DIN ISO 11929	(2011-01)	Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionizing radiation - Fundamentals and application (ISO 11929:2010)
DIN EN 60325	(2005-02)	Radiation protection instrumentation - Alpha, beta and alpha/beta (beta energy > 60 keV) contamination meters and monitors (IEC 60325:2002, modified); German version EN 60325:2004
DIN EN 61098	(2008-02)	Radiation protection instrumentation - Installed personnel surface contamination monitoring assemblies (IEC 61098:2003, modified); German version EN 61098:2007