Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 1502 (2022-11)

Monitoring Volumetric Activity of Radioactive Substances in the Inner Atmosphere of Nuclear Power Plants

(Überwachung der Aktivitätskonzentrationen radioaktiver Stoffe in der Raumluft von Kernkraftwerken)

The previous versions of these safety standard were issued in 2005-11, 2013-11 and 2017-11

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KTA SAFETY STANDARD

November 2022	Monitoring Volumetric Activity of Radioactive Substances in the Inner Atmosphere of Nuclear Power Plants	KTA 1502

Previous versions of this safety standard: KTA 1502.1: 1986-06 (BAnz No. 162a of September 3, 1986)
KTA 1502: 2005-11 (BAnz No. 101 a of May 31, 2006)
2013-11 (BAnz AT of January 17, 2014 B3)
2017-11 (BAnz AT of February 5, 2018 B3)

Contents

Comments by the editor:

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

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

Basic Principles

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

(2) Radiation monitoring and the monitoring of the activity concentration of radioactive substances bound to aerosols serve to protect the persons inside and outside of the plant from ionizing radiation and to keep under control the specified normal activity flow of solid, liquid and gaseous radioactive substances inside the plant, as well as the discharge of radioactive substances from the plant.

(3) Monitoring the activity concentration of radioactive substances in the inner atmosphere during specified normal operation contributes to fulfilling Secs. 8 and 9 StrlSchG, specifically, by

a) automatically initiating alarm signals when threshold limits are exceeded that are provided regarding increased activity concentration of radioactive substances in the inner atmosphere, and regarding the initiation of necessary measures,

b) identifying the respective compartment groups where an increased activity concentration of radioactive substances can lead to an increase of the discharge of radioactive substances with the vent stack air,

c) finding indications of leaking systems or components that contain radioactive substances (leakage monitoring of plant equipment and components) by detecting an increased activity concentration of radioactive substances bound to aerosols,

d) detecting increased activity concentrations of radioactive substances bound to aerosols with special regard to the protection of persons.

The monitoring equipment concerned must meet the requirements of Sec. 90 StrlSchV.

(4) The equipment required for these tasks are structurally organized as being:

a) Stationary measuring or sampling equipment, in particular, for monitoring the activity concentration of radioactive substances bound to aerosols in the exhaust-air collecting ducts, and

b) Non-stationary measurement and sampling equipment for monitoring the activity concentration of radioactive substances bound to aerosols in the inner atmosphere of the compartments regarding, in particular, the radiation protection monitoring of work places.

(5) Whenever compartments or compartment groups are to be monitored with regard to a possible leakage from components or from pipe lines carrying radioactive media as well as to the possible release of radioactive substances into the inner atmosphere, this is done by taking air specimens from the exhaust-air collecting ducts or directly from the inner atmosphere. This task is performed, primarily, by stationary measuring equipment. With regard to the discharge of radioactive substances through the vent stack, a monitoring of the exhaust-air ducts simplifies identifying the sources. Monitoring the activity concentration of radioactive substances bound to aerosols in compartments and compartment groups provides an indication of the average activity concentration of radioactive substance in the inner atmosphere and, thus, helps the decision-making process regarding the accessibility of the compartments by personnel and regarding the deployment of additional non-stationary measuring equipment. It also helps detecting any increase of the activity concentration of radioactive substances bound to aerosols in the inner atmosphere, thus enabling the initiation of necessary measures in case of escaping radioactive substances bound to aerosols as well as the automatic actuation of alarm signals whenever threshold limits are exceeded.

(6) The activity concentration of radioactive substances bound to aerosols in the inner atmosphere at the work places is monitored, primarily, by non-stationary measuring or sampling equipment. However, in individual cases this monitoring can be carried out by suitably located stationary measuring equipment, e.g., which is located at the work place, provided, it is ensured that this equipment delivers measurement results that are representative for the air at the work place. Non-stationary measuring and sampling equipment are also used for, e.g., leakage detection and the collection of data required for planning prior to the execution of a work task.

1 Scope

This safety standard applies to the specified normal operation of nuclear power plants with light water reactors during.

Notes:

(1) The stationary measuring or sampling equipment designed pursuant to this safety standard with special regard to specified normal operation, will also be able to provide information on design basis accidents, at least in their initial phases, regarding matters specified under Section Basic Principles, para. (3), items a) through d).

(2) If it becomes impossible during a design basis accident to perform onsite measurements with non-stationary measuring or sampling equipment, suitable specimens, when required, may be analyzed and evaluated in the laboratory.

2 Definitions

(1) Exhaust-air duct

An exhaust-air duct is a ventilation duct that guides the exhaust air out of a compartment.

(2) Exhaust-air collecting duct

An exhaust-air collecting duct is a ventilation duct that guides the exhaust air out of one or more compartment groups.

(3) Aerosol monitor

An aerosol monitor is a monitoring equipment for measuring the activity concentration of the cumulative beta activity or cumulative gamma activity caused by radioactive substances bound to aerosols.

(4) Discrimination of a measuring equipment

The discrimination of a measuring equipment is the ratio of the display value of a measured quantity to the actual value of this measured quantity.

(5) Specified normal operation

Specified normal operation includes:

a) Operating processes for which the plant, assuming the functional condition of all systems (unperturbed condition), is intended and suited (normal condition);

b) Operating conditions which occur in the event of malfunctions in parts of the plant or in systems (perturbed condition), in so far as safety-related reasons do not stand against continuing the operation (abnormal operation);

c) Maintenance procedures (inspections, servicing, repair).

(6) Cumulative beta activity

The cumulative beta activity is the ratio of the integrally determined activity of the beta radiation from a radioactive substance to the activity of a reference nuclide used for calibrating the measuring equipment.

(7) Cumulative gamma activity

The cumulative gamma activity is the ratio of the integrally determined activity of the gamma radiation from a radioactive substance to the activity of a reference nuclide used for calibrating the measuring equipment.

(8) Calibration of the measuring equipment for radiation monitoring

The calibration of the measuring equipment for radiation monitoring is the determination of the relationship between the value defined by specific norms (e.g., activity of the calibration source) and the displayed value (e.g., count rate) of the measurement parameter.

(9) Measuring equipment

Measuring equipment comprises the entirety of all measuring devices and auxiliary equipment that are required for measuring a measurement parameter, for transferring and adapting a measurement signal and for passing on a measured value as image of the measurement parameter.

(10) Measurement medium

A measurement medium is a sample taken from the medium to be monitored that passes through the measurement volume (i.e., the spatial region for which the discrimination was determined during calibration of the respective measuring equipment), possibly, after having been subjected to a specific physical treatment, e.g., heating, filtration, thinning.

(11) Detection limit

The detection limit is a calculated value of a measurement parameter (e.g., activity, activity concentration, specific activity) that is normally compared to a predetermined reference value in order to decide whether or not the measuring procedure is suited for a particular measurement task.

N o t e s :

(1) Detection limits are determined in accordance with DIN EN ISO 11929-1.

(2) Application examples are given in report KTA-GS 82.

(12) Monitoring the inner atmosphere

Monitoring the inner atmosphere means monitoring the radioactive substances contained in the inner atmosphere.

(13) Sampling equipment

Sampling equipment comprises the technical devices for the removal and storage of radioactive substances from gaseous or liquid media for a later analysis in the laboratory.

(14) Aerosols

Aerosols are solid or liquid particles suspended in air or in a gaseous medium.

(15) Monitoring

Monitoring is a collective term for all types of controlled data acquisition of physical parameters and includes the process of comparing these data with specified values.

N o t e :

Monitoring is carried out, e.g., in the form of

a) continuous measurements or
b) analysis of test specimens (e.g., in the laboratory) or
c) concatenation of measured values

always in conjunction with a comparison of the results with previously specified values for the physical parameters (e.g., licensed values, operational values).

3 Compartments and Compartment Groups Relevant to Monitoring

3.1 General Requirements

The activity concentration of radioactive substances bound to aerosols in the inner atmosphere shall be monitored in those compartments and compartment groups where radioactive substances can be released. This shall be carried out as follows:

a) Monitoring by using stationary, continuously measuring equipment for the specimens collected from representative locations in the inner atmosphere, from the exhaust-air duct of the compartment, or from the exhaust-air collecting ducts of the compartment groups. Additionally, stationary sampling equipment may be deployed, e.g., in individual exhaust-air ducts.

   N o t e :

   (1) The requirements regarding the measuring equipment dedicated to monitoring the activity concentration of radioactive substances bound to aerosols in the inner atmosphere depend on the release of radioactive substances (radioactive noble gases, radioactive substances bound to aerosols, radioactive iodine) possibly released into the inner atmosphere, and on the design of the air conditioning facilities (e.g., recirculated air filtration, air exchange rate).

   (2) Already in the design phase of the nuclear power plants, various compartments, usually, are considered as groups with regard to air conduction. This in mind, Section 3.2 specifies examples for the compartment groups that shall be monitored using stationary measuring equipment.

   (3) By monitoring the activity concentration of radioactive substances bound to aerosols in the air of the exhaust-air collecting duct of a compartment group, an early detection of an increase in air contamination of the associated compartment group is made possible.

b) Monitoring by using non-stationary measuring or sampling equipment, namely

   ba) at the work place with special regard to personal protection if the possibility for an incorporation relevant to radiological protection exists, and

   bb) if it becomes necessary to localize a leakage.

c) Monitoring by non-continuous sampling at special sampling nozzles that are to be provided as specified under Section 4.1.1.2.

3.2 Monitoring by Using Stationary Measuring Equipment

3.2.1 Nuclear power plant with pressurized water reactor (PWR)

3.2.1.1 Compartment groups

The typical compartment groups of a PWR are shown schematically in **Figure 3-1**. These are:

a) Compartment Group 1, inside the containment

   Compartment Group 1 inside the containment is comprised of the compartments directly enclosing the primary coolant circuit.

b) Compartment Group 2, inside the containment

   Compartment Group 2 inside the containment is comprised of the compartments which house activity-retaining components that do not belong to Compartment Groups 1 or 3.

c) Compartment Group 3, inside the containment

Compartment Group 3 inside the containment is comprised of the compartments containing the fuel pool as well as of all compartments inside the containment vessel that do not contain any components that transport primary coolant.

d) Compartment group Reactor Building Annulus

The compartment group Reactor Building Annulus is comprised of the compartment located between the containment and the outer concrete shell of the reactor building.

e) Compartment group Reactor Auxiliary Building

The compartment group Reactor Auxiliary Building is comprised of those compartments outside of the reactor building that are located within a controlled access area and that either contain systems and components with radioactive substances or in which radioactive substances are handled (e.g., laboratory rooms, hot workshop).

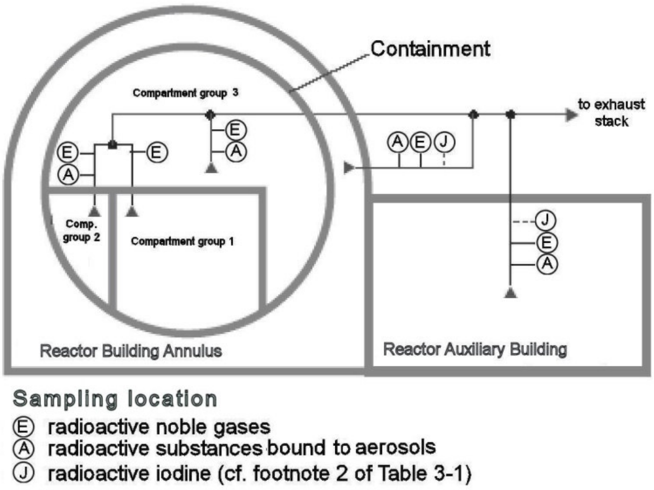

Figure 3-1: Typical system for monitoring the inner atmosphere of a nuclear power plant with PWR

3.2.1.2 Measured objects

The stationary measuring equipment specified under Section 3.1, item a), shall be used to monitor the radionuclide groups listed in **Table 3-1**.

Compartment Group	***Radionuclide Groups*** *whose activity concentration shall be monitored*		
	Noble gases	***Aerosols***	***Iodine***
Compartment Group 1, inside the containment	X	X [1]	-
Compartment Group 2, inside the containment	X	X	-
Compartment Group 3, inside the containment	X	X	-
Reactor Building Annulus	X	X	X [2]
Reactor Auxiliary Building	X	X	X [2]

1) During air-flushing operation. Monitoring may be accomplished by switching over to the measuring equipment of another compartment group.

2) If necessary, e.g., for the activation of stationary filter facilities.

Table 3-1: Radionuclide groups whose activity concentration**s** shall be monitored in a nuclear power reactor with PWR

3.2.2 Nuclear power plant with boiling water reactor (BWR)

3.2.2.1 Compartment groups

The typical compartment groups of a BWR are shown schematically in **Figure 3-2**. These are:

a) Containment

The compartment group Containment is comprised, essentially, of the compartments which house the reactor with the control rod drive system and the pressure suppression system.

b) Reactor Building

The compartment group Reactor Building is comprised, essentially, of the compartments which house the fuel pool, the residual heat removal systems and the air-conditioning systems.

c) Reactor Auxiliary Building

The compartment group Reactor Auxiliary Building is comprised of the compartments which house the auxiliary plant components and facilities.

d) Nuclear Services Building

The compartment group Nuclear Services Building is comprised of the compartments which house the storage facilities, laboratories and exhaust air facilities.

e) Steam Turbine Building

The compartment group Steam Turbine Building is comprised of those compartments which house the primary-coolant-steam driven turbine and the associated systems transporting primary coolant and feedwater.

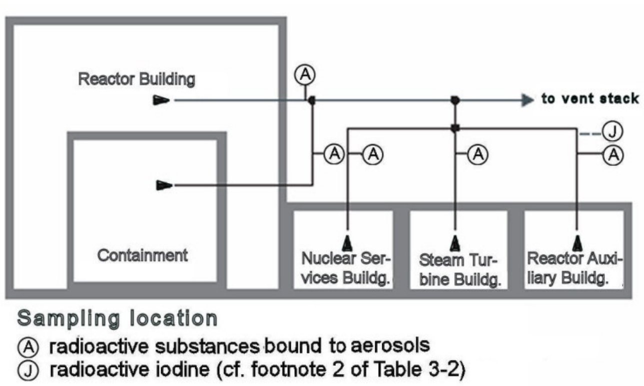

Figure 3-2: Typical system for monitoring the inner atmosphere of a nuclear power plant with BWR

3.2.2.2 Measured objects

The stationary measuring equipment specified under Section 3.1, item a), shall monitor the radionuclide groups listed in **Table 3-2**.

N o t e :
The activity concentration of radioactive noble gases does not have to monitored in a BWR because the content of radioactive noble gases is very small on account of the continued deaeration of the coolant.

3.3 Monitoring by Using Non-stationary Measuring or Sampling Equipment

If monitoring requires the use of non-stationary measuring or sampling equipment specified under Section 3.1, item b), this monitoring shall be performed under consideration of the air contamination to be expected from radioactive noble gases, from radioactive substances bound to aerosols or from radioactive iodine or tritium.

Note:

The activity concentration of tritium, e.g., in the compartment group Nuclear Services Building, can be monitored, e.g., by analyzing samples taken from the condensate of the circulating-air cooler.

Compartment Group	***Radionuclide Groups*** *whose activity concentration shall be monitored*	
	Aerosols	***Iodine***
Containment	X [1)]	-
Reactor Building	X	-
Reactor Auxiliary Building	X	X [2)]
Nuclear Services Building	X	-
Steam Turbine Building	X	-

1) During air-flushing operation. Monitoring may be accomplished by switching over to the measuring equipment of another compartment group.
2) If necessary, e.g., for the activation of stationary filter facilities.

Table 3-2: Radionuclide groups whose activity concentration**s** shall be monitored in a nuclear power reactor with BWR

4 Measuring Procedures

4.1 General Requirements

4.1.1 Sampling from air ducts

The sampling location and the sampling procedure shall be chosen such that the samples taken are representative for the exhaust air of the compartment groups or work places that are to be monitored. The number of sampling probes shall depend on the degree of intermixing of the exhaust air at the respective sampling location.

Note:

Sampling procedures are dealt with in standard DIN ISO 2889.

4.1.1.1 Sampling pipe lines

Sampling pipe lines shall be designed and routed and shall be manufactured from such materials that only the least possible amounts of radioactive substances bound to aerosols and of gaseous radioactive iodine compositions will be retained.

Note:

Design details are dealt with in standard DIN ISO 2889.

4.1.1.2 Sampling nozzles in the exhaust-air ducts and the exhaust-air collecting ducts

Sampling nozzles for taking air samples shall be installed in the exhaust-air ducts or the exhaust-air collecting ducts to enable non-continuous sampling.

4.1.1.3 Sampling duration

Regarding the continuous monitoring of radioactive substances bound to aerosols and of radioactive iodine, the sampling duration shall normally not exceed two weeks. The filter shall be exchanged in a shorter interval if an amassing of dust has caused a reduction of the flow rate by more than 20 %, or in case the activity from the amassed radioactive substances bound to aerosols impairs proper performance of the measurement task.

4.1.1.4 Filter bracket and sampling equipment

Care shall be taken that the measurement is not falsified by a contamination of the sampling and collecting equipment and, especially, of the filter bracket. It shall be easy to exchange the filters. The leakage air current shall always be negligible with respect to the partial air current for sampling.

4.1.2 Installation of the measuring equipment

The measuring equipment shall be installed such that they are sufficiently protected against any influences that could detrimentally affect their proper function, e.g., background radiation at the location of the detector. The measuring equipment shall normally be easily accessible with regard to testing, servicing and repair.

4.1.3 Design of the measuring equipment with regard to ambient conditions

(1) The stationary and the non-stationary measuring equipment shall be designed with regard to the ambient and measurement media conditions as well as to the operating voltage ranges specified in **Table 4-1.**

(2) Within its nominal operating range as listed in **Table 4-1**, the measurement value may not vary by more than ± 30 % with respect to the measurement value when any individual influence parameter is varied. During each variation, with the exception of the pressure of the ambient air and the measurement medium, all the other influence parameters (e.g., filter loading and background radiation) shall, as far as possible, remain unchanged and close to the reference values. However, the pressure difference between measurement medium and ambience shall normally not exceed 200 hPa.

(3) The reference values listed for the individual influence parameters in **Table 4-1** shall be applied. The reference value for filter loading shall be the fresh (non-loaded) condition. The reference value for the background radiation shall be specified by the manufacturer.

4.1.4 Discrimination for other types of radiation

It is necessary that the discrimination of gamma ray sensitive detectors to the beta radiation of Strontium-90/Yttrium-90 and the discrimination of beta ray sensitive detectors to the gamma radiation of Cobalt-60 or Cesium-137 is known.

4.1.5 Adjustment devices

All measuring equipment which require adjustments in the course of operation shall be equipped with corresponding adjustment devices. The adjustment devices on the electronic devices of the monitoring equipment shall be arranged and secured such that adjustments by unauthorized persons can be largely ruled out. No self-adjustment shall be possible.

4.1.6 Count rate loss and overload resistance

It is necessary that possible count rate losses of the measuring equipment within the measurement range (e.g., from delay times) are known as a function of the count rate and are taken into account. It is not permissible that display values diminish due to an increase of the measurement parameter (overloading).

4.1.7 Signal generators and alarm devices

(1) The measuring equipment shall be equipped with one signal generator for indicating equipment failure and at least one signal generator for an upper threshold limit.

(2) In the case of stationary measuring equipment, an equipment failure and the exceeding of threshold limits shall cause optical and acoustic alarms in the central control room. An undershooting of the lower threshold limit may be combined with

other alarm signals of the respective equipment as a group alarm. Additionally, a separate signal should indicate that a test operation is being performed. Group alarms may be used for the central control room, provided, it is possible in the control room or in a control room annex to trace the alarm signal back to the originating measuring equipment. If the acoustic alarm signals are individually or mutually reset prior to alleviating the cause of the fault, the optical signals in the central control room indicating that an equipment has failed or that an the upper threshold limit has been exceeded shall continue to indicate the individual alarm condition.

(3) It shall be possible to attach acoustic and optical warning devices to the non-stationary measuring equipment.

4.1.8 Assured power and operating media supplies

(1) If the stationary measuring equipment requires an operating medium, e.g., counter gas, the supply of this operating medium shall be assured and shall be monitored for any failure.

(2) The electrical power loads of stationary measuring equipment shall be connected to the emergency power supply system, and the electronic power loads shall be connected to the uninterruptible emergency power supply system with a battery operating in parallel. Stationary measuring equipment shall be designed to be self-monitoring. It shall be ensured (e.g., by a connection to the uninterruptible emergency power supply system) that, after a switching-over to an emergency power supply, the functional capability of the measuring equipment will not be impermissibly affected.

4.1.9 Statistical safety

(1) The factor $k_{1-\alpha}$ in accordance with DIN EN ISO 11929-1 shall be set equal to 1.645.

(2) The factor $k_{1-\beta}$ in accordance with DIN EN ISO 11929-1 shall be set equal to 1.645.

(3) The detection limits shall be determined with the influence parameters being adjusted to the reference values listed in **Table 4-1**. The detection limits shall be determined at an ambient dose rate of 0.25 µGy/h (Cesium-137).

Note:

The determination of the detection limits for nuclear radiation measurements is dealt with in standard DIN EN ISO 11929-1.

4.2 Special Requirements for Monitoring the Activity Concentration of Radionuclide Groups

Note:

The parameters specified in this section are collectively summarized **Tables 4-2** through **4-4**.

4.2.1 Radioactive noble gases

4.2.1.1 Monitoring with stationary measuring equipment

(1) The cumulative beta activity concentration of radioactive noble gases shall be measured using integral beta ray measuring equipment. To avoid any falsification of the measured values, a high-efficiency particulate air filter of at least Filter Class E12 in accordance with DIN EN 1822-1 shall be installed upstream of the equipment. If necessary, this air filter shall be shielded.

(2) The sampling-related volumetric flow rate shall be monitored. If this volumetric flow rate falls below the required value by more than 20 %, this fact shall be recorded and indicated by optical and acoustic alarms in the central control room.

(3) The detection limit for the activity concentration shall basically be smaller than 1 x 10^4 Bq/m^3 relative to Xenon-133 in a one-hour long measurement period. The exception is the measuring equipment in the exhaust-air collecting duct of the Compartment Group 1 of a PWR; the detection limit of this equipment does not need to be smaller than 5 x 10^4 Bq/m^3 relative to Xenon-133.

(4) The upper limit of the measurement range of the measuring equipment shall basically be at least 5 x 10^8 Bq/m^3 relative to Xenon-133. The exception is the measuring equipment in the exhaust-air collecting duct of Compartment Group 1 of a PWR: the upper limit of this equipment shall be at least 5 x 10^9 Bq/m^3 relative to Xenon-133.

4.2.1.2 Monitoring with non-stationary measuring or sampling equipment

(1) The activity concentration of radioactive noble gases shall be measured using integral beta ray measuring equipment. To avoid any falsification of the measured values, a high-efficiency particulate air filter of at least Filter Class E12 in accordance with DIN EN 1822-1 shall be installed upstream of the equipment. If necessary, this air filter shall be shielded.

(2) In a one-hour long measurement period, the detection limit for activity concentration shall be smaller than 1 x 10^5 Bq/m^3 relative to Xenon-133.

(3) The upper limit value of the measurement range of the measuring equipment shall be at least 5 x 10^8 Bq/m^3 relative to Xenon-133.

(4) The volumetric flow rate through the measuring equipment shall be monitored. An alarm shall be issued, both, if the volumetric flow rate falls below a lower threshold limit and if it exceeds an upper threshold limit.

(5) The sampling and collecting of specimens can be performed manually by using gas collector tubes or pressure bottles and by analyzing the samples in the laboratory.

4.2.2 Radioactive substances bound to aerosols

4.2.2.1 Monitoring with stationary measuring equipment

(1) The activity concentration of radioactive substances bound to aerosols shall be monitored. This shall be achieved by continuously accumulating the radioactive substances bound to aerosols from a partial air stream on a high-efficiency particulate air filter of at least Filter Class E12 in accordance with DIN EN 1822-1, and simultaneously measuring the activity on the high-efficiency particulate air filter.

(2) The volumetric flow rate of the partial air stream used for this accumulation on the filter shall be monitored. A deviation of more than 20 % from the required value shall be recorded and indicated by optical and acoustic alarms in the central control room.

(3) A measurement value shall be determined from the ionizing radiation caused by the filter loading; this value (e.g., detector pulse rate) shall serve as a measure for the activity loading of the high-efficiency particulate air filter or as a measure for the activity concentration of radioactive substances bound to aerosols in the monitored air (e.g., gradient of the detector pulse rate including, if necessary, a decay correction). The background level of the detector signal and the influence of natural radioactive substances bound to aerosols on the detector signal may be suppressed when processing the measurement values.

Note:

The measurement of the activity concentration of radioactive substances bound to aerosols can be falsified by interferences, e.g., from aerosols trapped in the high-efficiency particulate air filters that carry naturally created radioactive substances and from noble gases, and these interferences shall be taken into account when interpreting the measurement results.

(4) The measuring equipment shall be designed such that, starting out with a fresh (non-loaded) high-efficiency particulate air filter, the display of the measurement parameter “Activity on the filter” or of the measurement parameter “Increasing activity on the filter” will exceed the detection limit within the maximum time of one hour after an influx of radioactive substances bound to aerosols with a time integrated activity concentration of 10 (Bq/m^3)h.
The test regarding fulfillment of this requirement is specified in Section 5.2.2.1.
Both in the compartment group Containment of a BWR and in the Compartment Groups 1 and 2 of a PWR, the corresponding time integral for the aerosol monitors for monitoring the radioactive substances bound to aerosols is 100 (Bq/m^3)h.

Notes:

(1) The determination of the detection limits with regard to nuclear radiation measurements is dealt with in standards DIN EN ISO 11929-1.

(2) The specified requirements regarding detection limits apply to the plant-independent verification of the equipment characteristics.

(5) The activity on the high-efficiency particulate air filter shall be monitored with regard to a specific value at which radioactive substances bound to aerosols with a time integrated activity concentration of 500 (Bq/m^3)h can be detected within less than one hour with a standard deviation of 10 % or less. If this specific value is exceeded and the value of the actual activity concentration of radioactive substances bound to aerosols cannot anymore be determined with a standard deviation of 10 % or less, the high-efficiency particulate air filter shall be exchanged. A clearly perceptible alarm shall be triggered whenever a specified loading of the filter with radioactive substances bound to aerosols is exceeded. Irrespective of this requirement, the filter shall be exchanged at least every 14 days.

(6) The measuring equipment shall be designed such that the measurement value specified under para. (3), can be formed, displayed and registered up to a activity concentration of radioactive substances bound to aerosols of 5 x 10^4 Bq/m^3 and up to a time integrated activity concentration of 10^5 (Bq/m^3)h.

(7) The reference nuclide for the requirements specified under paras. (3) through (6) shall be Cesium-137.

4.2.2.2 Monitoring with non-stationary measuring or sampling equipment

(1) The activity concentration of radioactive substances bound to aerosols at work places shall be monitored by accumulating the radioactive substances bound to aerosols from an air stream with a constant volumetric flow rate on a high-efficiency particulate air filter of at least Filter Class E12 in accordance with DIN EN 1822-1 and measuring the activity of the radioactive substances bound to aerosols accumulated on the high-efficiency particulate air filter either already while it is accumulating (direct measurement) or, subsequently, by analyzing the loaded filter in the laboratory.

(2) The volumetric flow rate of the partial air stream used for this accumulation on the filter shall be monitored. A deviation by more than 20 % from the required value shall be indicated onsite by optical and acoustic alarms. In the case of sampling equipment, the volumetric throughput shall be determined.

Note:

The accumulation duration and the dust freight of the specimen air can influence the volumetric flow rate of the sampling equipment.

(3) In the case of the direct measurement, a measurement value shall be determined from the ionizing radiation caused by the filter loading; this value (e.g., detector pulse rate) shall serve as a measure for the activity loading of the high-efficiency particulate air filter or as a measure for the activity concentration of radioactive substances bound to aerosols in the monitored air (e.g., gradient of the detector pulse rate including, if necessary, a decay correction). The background level of the detector signal and the influence of natural radioactive substances bound to aerosols on the detector signal may be suppressed when processing the measurement values.

(4) The measuring equipment shall be designed such that, starting out with a fresh (non-loaded) high-efficiency particulate air filter, the display of the measurement parameter “Activity on the filter” or of the measurement parameter “Increasing activity on the filter” will exceed the detection limit within the maximum time of one hour after an influx of radioactive substances bound to aerosols with a time integrated activity concentration of 10 (Bq/m^3)h.
The test regarding fulfillment of this requirement is specified in Section 5.2.2.1.

Note:

The specified requirements regarding detection limits apply to the plant-independent verification of the equipment characteristics.

(5) The measuring equipment shall be designed such that the measurement value of the direct measurement specified under para. (3) can be formed and displayed up to a activity concentration of the radioactive substances bound to aerosols of 5 x 10^4 Bq/m^3 and up to a time integrated activity concentration of 10^5 (Bq/m^3)h.

(6) If a direct measurement shows that the end of the display range is reached, it shall be checked whether a laboratory evaluation of the filters has become necessary or not.

(7) In the laboratory analysis, the activity loading of the high-efficiency particulate air filter shall be determined either by integral measurements of the cumulative beta or gamma activity concentration of the reference nuclide, or by nuclide-specific measurements.

(8) With regard to laboratory measurements, the measurement and sampling equipment shall be designed such that an average activity concentration of radioactive substances bound to aerosols of 5 Bq/m^3 can be detected within two hours from the start of sampling.

(9) If work place monitoring, in addition to the laboratory measurements, also employs directly measuring equipment onsite, this measuring equipment shall be designed such that, starting out with a fresh (non-loaded) high-efficiency particulate air filter, the display of the measurement parameter “Activity on the filter” or of the measurement parameter “Increasing activity on the filter” will exceed the detection limit within the maximum time of one hour after an influx of radioactive substances bound to aerosols with a time integrated activity concentration of 100 (Bq/m^3)h.
The test regarding fulfillment of this requirement is specified in Section 5.2.2.1.

Notes:

(1) The determination of the detection limits with regard to nuclear radiation measurements is dealt with in standards DIN EN ISO 11929-1.

(2) The specified requirements regarding detection limits apply to the plant-independent verification of the equipment characteristics.

(10) The reference nuclide for the requirements specified under paras. (4), (5), (8) and (9) shall be Cesium-137.

4.2.3 Radioactive gaseous iodine

4.2.3.1 Monitoring with stationary measuring equipment

(1) The continuous monitoring of the activity concentration of radioactive iodine shall be performed by accumulating the gaseous iodine compositions from a partial air stream with a con-

stant volumetric flow rate on an iodine filter and by simultaneously measuring the activity of the radioactive iodine accumulated on the iodine filter.

Note:

The radiologically relevant iodine isotope is Iodine-131.

(2) The volumetric flow rate of the partial air stream used for the iodine accumulation shall be monitored. A deviation by more than 20 % from the required value shall be recorded and indicated by optical and acoustic alarms in the central control room.

(3) A measurement value shall be determined from the gamma radiation caused by the filter loading; this value (e.g., detector pulse rate) shall serve as a measure for the activity loading of the iodine filter or as a measure for the activity concentration of radioactive iodine in the monitored air (gradient of the detector pulse rate).

Note:

The measurement of the activity concentration of radioactive iodine can be falsified, e.g., by noble gases in the medium; this shall be taken into account when interpreting the measurement results.

(4) The activity on the iodine filter shall be monitored with regard to a specific value at which radioactive iodine with a time integrated activity concentration of 500 (Bq/m^3)h can be detected within less than one hour with a standard deviation of 10 % or less. If this specific value is exceeded and the value of the actual activity concentration of radioactive iodine cannot anymore be determined with a standard deviation of 10 % or less, the iodine filter shall be exchanged. A clearly perceptible alarm shall be triggered whenever a specified loading of the filter with radioactive iodine is exceeded.

(5) The direct measurement specified under para. (3) shall be performed with measuring equipment designed such that the measurement value can be formed and displayed up to a activity concentration of radioactive iodine of 2 x 10^3 Bq/m^3 and up to a time integrated activity concentration of 2 x 10^4 (Bq/m^3)h.

(6) The measuring equipment for measuring the activity concentration of radioactive iodine listed in **Table 3-1** or **3-2** shall be designed such that, starting out with a fresh (non-loaded) iodine filter, the display of the measurement parameter “Activity on the filter” or of the measurement parameter “Increasing activity on the filter” will exceed the detection limit within the maximum time of one hour after an influx of radioactive iodine with a time integrated activity concentration of 10 (Bq/m^3)h.
The test regarding fulfillment of this requirement is specified in Section 5.2.2.1.

Notes:

(1) The determination of the detection limits with regard to nuclear radiation measurements is dealt with in standards DIN EN ISO 11929-1.

(2) The specified requirements regarding detection limits apply to the plant-independent verification of the equipment characteristics.

(7) The reference nuclide for the requirements specified under paras. (4) through (6) shall be Iodine-131.

(8) The design of the filter cartridge and the choice of filter material shall be such that, even for organically bound iodine, a separation efficiency of at least 90 % is achieved. The permissible temperature range of the iodine sorption material shall be specified and adhered to.

(9) In order to reduce interference from radioactive noble gases absorbed in the filter material, the sorption material chosen shall be such that it has a low retention capability for noble gases.

4.2.3.2 Monitoring with non-stationary measuring or sampling equipment

(1) The monitoring of the activity concentration of radioactive iodine at the work place shall be performed by accumulating the gaseous iodine compositions from a partial air stream with a constant volumetric flow rate on an iodine filter and by simultaneously measuring the activity of the radioactive iodine accumulated on the iodine filter.

(2) The volumetric flow rate of the partial air stream used for accumulating the iodine in the measuring equipment shall be monitored. A deviation by more than 20 % of the required value shall be indicated onsite by optical and acoustic alarms. In the case of sampling equipment, the volumetric throughput shall be determined.

(3) The design of the filter cartridge and the choice of filter material shall be such that, taking the volumetric flow rate into account, a separation efficiency of at least 90 % is achieved even for organically bound iodine. The permissible temperature range of the iodine sorption material shall be specified and adhered to.

Note:

The separation efficiency of the filter material can be reduced by light, air, humidity and aging.

(4) A measurement value shall be determined from the gamma radiation caused by the filter loading; this value (e.g., detector pulse rate) shall serve as a measure for the activity loading of the iodine filter.

(5) If, in addition to the laboratory measurements, the work place monitoring also employs directly measuring equipment onsite, this measuring equipment shall be designed such that, starting out with a fresh (non-loaded) iodine filter, the display of the measurement parameter “Activity on the filter” or of the measurement parameter “Increasing activity on the filter” will exceed the detection limit within the maximum time of one hour after influx of radioactive iodine with a time integrated activity concentration of 10 (Bq/m^3)h. If a higher sampling-related volumetric flow rate is chosen in order to further decrease the detection limit and if this leads to a reduced separation efficiency for organically bound iodine (< 90 %), the related uncertainties shall be declared when specifying the detection limit. The minimum separation efficiency of the measuring equipment shall be specified by its manufacturer.
The test regarding fulfillment of this requirement is specified in Section 5.2.2.1.

Notes:

(1) The determination of the detection limits with regard to nuclear radiation measurements is dealt with in standards DIN EN ISO 11929-1.

(2) The specified requirements regarding detection limits apply to the plant-independent verification of the equipment characteristics.

(6) The reference nuclide for the requirement specified under para. (4) shall be Iodine-131.

(7) In order to reduce interference from radioactive noble gases absorbed in the filter material, the sorption material chosen shall normally be such that it has a low retention capability for noble gases.

(8) With regard to laboratory measurements, the measurement and sampling equipment shall be designed such that an average activity concentration of radioactive iodine of 20 Bq/m^3 can be detected within two hours from the start of sampling.

4.3 Measurement Data Display, Recording and Documentation

4.3.1 Monitoring with stationary measuring equipment

(1) The display and automatic recording devices for the measurement data shall be located in the main control room or in a control room annex. No multi-track plotters or multi-track printers used shall have more than six tracks. The recorded tracks shall be directly visible for a time period of at least three hours and shall be well legible.

(2) In the case of measuring equipment with switchable display ranges, the respective display range shall also be recorded.

(3) If the measurement value display is exclusively on a linear scale, an automatic switch-over of the measuring range shall be provided.

(4) In case of an electronic recording of the measurement data, the measurement data shall be stored redundantly. The storage capacity shall be sufficiently large to keep available the measurement data and the alarms over the last twelve months.

(5) The recorded data shall be evaluated in regular intervals and shall be stored in accordance with legal regulations or the provisions of the proper authorities.

4.3.2 Monitoring with non-stationary measuring equipment

(1) The non-stationary measuring equipment employed for monitoring the activity concentration of radionuclide groups in compartments shall be designed such that the measurement data is displayed directly on the measuring equipment.

(2) If the work place monitoring with non-stationary measuring equipment shows that within a time period of eight hours the time integrated activity concentration of radioactive substances bound to aerosols exceeds 80 (Bq/m^3) h and that of radioactive iodine 120 (Bq/m^3)h, then the measurement data shall be recorded.

Influence Parameters	*Nominal Operating Range*	*Reference Value*
Operating voltage		
Alternating current voltage supply	85 % to 110 % of the nominal operating voltage	manufacturer specification
Direct current voltage supply	specified voltage range of the DC voltage grid	manufacturer specification
Ambient temperature	15 °C to 40 °C	20 °C
Pressure of ambient atmosphere	900 hPa to 1100 hPa	manufacturer specification
Relative humidity of ambient atmosphere	10 % to 95 %, non-dewing	60 %
Temperature of measurement medium	15 °C to 40 °C	20 °C
Pressure of measurement medium 1)	700 hPa to 1100 hPa	manufacturer specification
Relative humidity of measurement medium	10 % to 95 %, non-dewing	60 %
1) The pressure difference between ambient atmosphere and measurement medium shall not exceed 200 hPa		

Table 4-1: Nominal operating ranges and reference values of the influence parameters (cf. Section 4.1.3 para. (2))

Characteristic Parameters	*Values of the Characteristic Parameters for*		
	Stationary Measuring Equipment *PWR and BWR*	*Stationary Measuring Equipment of Compartment Group 1* *PWR*	*Non-stationary Measuring or Sampling Equipment* *PWR and BWR*
Detection limit of the activity concentration of radioactive noble gasses	1×10^4 Bq/m^3	5×10^4 Bq/m^3	1×10^5 Bq/m^3
Upper limit of measuring range	5×10^8 Bq/m^3	5×10^9 Bq/m^3	5×10^8 Bq/m^3
Reference nuclide	Xenon-133		

Table 4-2: Characteristic parameters of the noble gas measuring equipment specified under Section 4.2.1

Characteristic Parameters	*Values of the Characteristic Parameters for*	
	Radioactive Substances Bound to Aerosols (cf. Section 4.2.2.2, para. (8))	*Radioactive Iodine (cf. Section 4.2.3.2, para. (8))*
Minimum activity concentration of radioactive substances bound to aerosols detectable within two hours	5 Bq/m^3	20 Bq/m^3
Reference nuclide	Cesium-137	Iodine-131

Table 4-3: Characteristic parameters for the sampling and for the laboratory evaluation of radioactive substances bound to aerosols and of radioactive iodine

Characteristic Parameters	***Values of the Characteristic Parameters for***			
	Radioactive Substances Bound to Aerosols			***Radioactive Iodine***
	stationary measuring equipment in the compartment group Containment of SWR and Compartment Group 1 and 2 of PWR	***other stationary and non-stationary measuring equipment***	***non-stationary measuring or sampling equipment with subsequent measurement in the laboratory***	***stationary and non-stationary measuring equipment***
Minimum time integrated activity concentration of radioactive substances [1)] detectable within one hour	100 (Bq/m^3)h	10 (Bq/m^3)h	100 (Bq/m^3)h	10 (Bq/m^3)h
Maximum measurable activity concentration [2)]	5 x 10^4 Bq/m^3			2 x 10^3 Bq/m^3
Up to a time integrated activity concentration [2)]	1 x 10^5 (Bq/m^3)h			2 x 10^4 (Bq/m^3)h
Reference nuclide to be used	Cesium-137			Iodine-131

1) Cf. Section 4.2.2.1, para. (4), Section 4.2.2.2, paras. (4) and (9), and Section 4.2.3.1, para. (6)

2) Cf. Sections 4.2.2.1, para. (6), Section 4.2.2.2, para. (5), and Section 4.2.3.1, para. (5)

Table 4-4: Characteristic parameters of the stationary and non-stationary measuring or sampling equipment for radioactive substances bound to aerosols and for radioactive iodine

5 Maintenance, Tests and Inspections

5.1 Maintenance

5.1.1 Execution

All servicing and repair measures on measuring or sampling equipment shall be performed in accordance with the individual operating and maintenance instructions by technically qualified personnel.

5.1.2 Documentation

All servicing and repair tasks performed on measuring or sampling equipment shall be documented. These records shall contain at least the following information:

a) Unambiguous identification of the respective equipment.

b) Type of servicing or repair task performed,

c) Type and number of replaced parts,

d) Reasons for the replacement of parts,

e) In case of newly replaced parts:

   Date and identifying description of the test certificates as well as of the verifications specified in the present safety standard.

f) Information on the outage times in case of stationary measuring or sampling equipment,

g) Date when the servicing or repair task was performed, as well as

h) Name and signature of the technically qualified persons.

5.2 Tests and Inspections

5.2.1 Point in time of tests and inspections

The measurement and sampling equipment shall be subjected to the following tests and inspections:

a) Prior to deployment in any nuclear power plant:

   aa) Verification of suitability, and

   ab) Calibration.

b) Prior to deployment in a specific nuclear power plant:

   ba) Suitability check,

   bb) Factory test,

   bc) Calibration check with solid calibration sources, and

   bd) Commissioning test.

c) During deployment in the nuclear power plant

   ca) Periodic inservice inspections, and

   cb) Tests and inspections after servicing and repair tasks.

5.2.2 Initial tests and inspections

5.2.2.1 Verification of suitability

(1) Prior to their initial deployment in a nuclear power plant it shall be verified that the measurement and sampling equipment can perform their tasks and that they meet the specified requirements.

Note:
Requirements regarding the suitability verification of the stationary measuring equipment for radiation monitoring are specified in safety standard KTA 1505.

(2) The verification of suitability consists of a plant-independent verification of the equipment characteristics and of a plant-dependent suitability check.

(3) The plant-dependent suitability check shall be performed by the proper authority or an authorized expert appointed by the proper authority.

5.2.2.2 Calibration and calibration check

(1) Prior to the first deployment of the equipment, suitable calibration factors shall have been specified for the measuring equipment including the measuring equipment for the volumetric flow rates. It is permissible to determine these calibration factors on type-identical measuring equipment. The calibration shall be carried out for the reference values specified in Table 4-1.

(2) The measuring equipment for monitoring the cumulative beta activity concentration of radioactive noble gases shall be calibrated using Xenon-133 and Krypton-85. The energy dependency of the discrimination of the measuring equipment for measuring the beta radiation of radioactive noble gases shall be determined with at least three representative beta nuclides having a maximum beta energy in the energy range from 150 keV to 2500 keV. The energy dependency of the discrimination of the measuring equipment for measuring the gamma radiation of radioactive noble gases shall be determined for a gamma energy in the energy range from 60 keV to 2500 keV.

(3) The measuring equipment for monitoring the cumulative beta activity concentration or the cumulative gamma activity concentration of radioactive substances bound to aerosols shall be calibrated, regarding beta radiation, by using Technetium-99 or Cobalt-60 as well as with Chlorine-36 or Cesium-137, and, regarding gamma radiation, by using Barium-133 and Cesium-137. The energy dependency of the discrimination of the measuring equipment for beta radiation shall be determined in the energy range from 150 keV to 2500 keV and for gamma radiation in the energy range from 100 keV to 1700 keV. In order to reduce the detection probability of interfering nuclides and of background radiation, the lower threshold of the measuring equipment for monitoring the activity concentration of radioactive substances bound to aerosols with regard to gamma radiation may be raised to a maximum of 250 keV.

(4) The measuring equipment for monitoring the activity concentration of radioactive iodine shall be calibrated using Iodine-131.

(5) During initial calibration at the manufacturer, a set of solid radiation sources shall be specified with each of which an individual display value in one of the lower and one of the upper decades of the measurement range is created and which can be used for future checks and for attaching type-identical equipment. This requires providing the following solid radiation sources:

a) For the monitoring of the activity concentration of radioactive noble gases with measuring equipment for beta radiation – Cobalt-60, Technetium-99 or Cesium-137;

b) For the monitoring of the activity concentration of radioactive substance bound to aerosols with measuring equipment for beta radiation – Cobalt-60 or Technetium-99, and with measuring equipment for gamma radiation – Barium-133 or Cobalt-57;

c) For monitoring the activity concentration of radioactive iodine – Barium-133.

(6) Subsequent to the initial calibration of the measuring equipment, a special display value – transfer value – shall be established using a solid radiation source in a defined and reproducible geometry which will enable checking the calibration as listed in **Table 5-1**, No. 1b.

(7) Prior to the initial deployment of the sampling equipment, suitable calibration factors shall be determined for the measuring equipment of volumetric flow rates.

5.2.2.3 Factory test

(1) A factory test shall be performed to verify proper manufacturing and functioning of the measuring equipment. If the measuring equipment consists of components from different manufacturers, proper manufacturing and functioning of these component shall be verified at the respective manufacturers.

(2) The factory test of the measuring equipment shall be performed as a production (or piece) test and shall comprise:

a) Visual inspection,

b) Test of the output value as a function of the specified operating voltage fluctuation,

c) Test of the characteristic using an impulse of current generator with at least one test value per decade of the measurement range,

d) Test of the overload resistance (electronically or with a radiation source),

e) Check of the discrimination specified under Section 5.2.2.2, para. (6),

f) Monitoring the flow rate, or measuring of the mass flow,

g) Testing for leak-tightness, and

h) Determination of the transfer value with a solid radiation source for the commissioning test.

(3) The factory test of the sampling equipment shall be performed as a production (or piece) test and shall comprise:

a) Visual inspection,

b) Monitoring of the flow rate, or measuring of the mass flow, and

c) Testing for leak-tightness.

(4) The factory test shall be performed by plant inspectors and, in well-founded cases, in the presence of the proper authority or of an authorized expert appointed by the proper authority.

5.2.2.4 Commissioning test

(1) A commissioning test shall be performed on the stationary measurement and sampling equipment after their installation to verify their proper construction and function.

a) The measuring equipment shall be tested regarding:
   - aa) Installation of the equipment,
   - ab) Construction quality of the equipment,
   - ac) Display (with at least one test value per decade of the measurement range),
   - ad) Calibration check (using a solid radiation source),
   - ae) Threshold value adjustments and the annunciation of data and alarms,
   - af) Flow rate monitoring,
   - ag) Measurement value processing,
   - ah) Supply of operating media,
   - ai) Equipment failure alarm, and
   - ak) Connection to the emergency power supply system.

b) The sampling equipment shall be tested regarding:
   - ba) Installation of the equipment,
   - bb) Construction quality of the equipment,
   - bc) Flow rate monitoring, and
   - bd) Measurement value processing.

(2) Prior to commissioning of a sampling equipment, the losses of radioactive substances bound to aerosols in the sampling pipe line shall be estimated and described by a correction factor. Unless measurement results from other plants are transferable, an experimental verification of the correction factor shall normally be performed on selected sampling pipe lines as soon as the operating conditions after plant commissioning allow.

(3) The commissioning tests shall be performed by the operating utility and, to the extent specified by the proper authority, by the proper authority or an authorized expert appointed by the proper authority, or in their presence.

(4) Under consideration of the onsite conditions (e.g., background radiation), the display values of the tests specified under para. (1), item ad), shall not deviate by more than 30 % from the transfer value determined by the factory test.

(5) The non-stationary measuring equipment shall be tested regarding:

a) Construction quality of the equipment,

b) Display (using an impulse of current generator with at least one test value per decade of the measurement range),

c) Calibration check (using a solid radiation source),

d) Data and alarm annunciation,

e) Flow rate monitoring,

f) Measurement value processing,

g) Supply of operating media, and

h) Equipment failure alarm.

5.2.3 Inservice inspections

5.2.3.1 General Requirements

(1) The test list, the test instructions and the test certificates shall be in accordance with safety standard KTA 1202.

(2) It shall be possible to perform the tests and inspections without any manipulation (e.g., soldering) of the electric circuit.

5.2.3.2 Periodic inservice inspections

(1) Periodic inservice inspections shall be performed to verify the proper function of the measurement and sampling equipment. **Table 5-1** lists the required tests and inspections and the respective test intervals.

(2) The verification of calibration listed in **Table 5-1**, No. 1, shall be performed on the measuring or sampling equipment with the same geometry and solid radiation source as during that part of the commissioning test specified under Section 5.2.2.4 para. (1), item ad). The display value shall be achieved with the accuracy specified in the testing manual.

(3) The tests and inspections shall be performed by the operating utility or by the proper authority or an authorized expert appointed by the proper authority.

5.2.3.3 Tests after repairs

After any repair, the proper functioning shall be verified by performing a commissioning test as specified under Section 5.2.2.4 to an extent that corresponds to the extent of the repair.

5.3 Elimination of Defects

The (maximum allowed) repair times and, if necessary, alternative measures shall be specified in the operating manual. Identified defects including the measures taken for their elimination shall be documented.

No.	Test Object	Testing Method	Test Frequency of the Equipment		
			Stationary		Non-stationary
			by the operating utility	by the proper authority or an authorized expert appointed by the proper authority	by the operating utility [1)]
1	1a Measuring or sampling equipment	Visual inspection	during inspection rounds	annually	during deployment
	1b Measuring equipment	Calibration check with a test source and, in the case of counter tubes, check of the plateau, if necessary	semi-annually	annually	at least annually
2	Test and maintenance records	Inspection	–	annually	–
3	Electronic modules	Integral test of the measurement transducer by inputting suitable signals at the input points provided for or by simulating signals directly at the input of the measurement transducer with at least one value per decade of the measuring range [2)]. Test of the output of the measurement transducer as well as of the recording equipment (e.g., displays, recorders, monitoring computers) by simulating at least one value within the measuring range; in case of computer-based measuring equipment, this signal may also be created by a keyboard-controlled computer program. Comparison of all displays and records.	annually	annually	–
4	Annunciation				
	Operational availability	Visual inspection	during inspection rounds	annually	prior to each deployment
	Lower threshold value	- by interrupting the power supply of the detector, or - by opening the signal connection between transducer and detector, or - by inputting a signal below the lower threshold value - in the case of digitally operating measuring or sampling equipment, it is sufficient to test the annunciation by applying the functions included in the software program, provided, the program has been tested and is self-monitoring	semi-annually	annually	annually
	Upper threshold value	by using a test source or an artificial excitation	semi-annually	annually	annually
5	Flow rate monitoring and operating media supply				
	without an automatic function control	Visual inspection	during inspection rounds	annually	prior to each deployment
	with an automatic function control	Comparison of the required value with the actual value	semi-annually	annually	annually
6	Sampling equipment	Visual inspection, check of the switching of ventilators or blowers	annually	annually	during deployment

1) The tests of non-stationary measuring or sampling equipment by the proper authority or an authorized experts appointed by the proper authority are specified in individual cases by the proper authority. Further guidance see also in KTA 1301.2.

2) This integral test of transducers and measurement circuits by simulating detector signals at the input of the transducer – with at least one value per decade – is not required in the case of computer-based measuring equipment, provided, the program has been tested and is self-monitoring. In this case, it is sufficient to input one signal in the upper decade of the measurement range, provided, the pre-processing electronics does not perform any switchovers in the entire measurement range. This test, also, may be waived if the calibration check is performed in the uppermost decade of the measurement range.

Table 5-1: Recurrent inservice inspections

Appendix

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) Atomic Energy Act in the version promulgated on July 15, 1985 (BGBl. I, p. 1565), most recently changed by article 1 of the act dated December 4, 2022 (BGBl. I, p. 2153)
StrlSchG		Act on the Protection against the Harmful Effect of Ionising Radiation (Radiation Protection Act - StrlSchG) Radiation Protection Act of June 27, 2017 (BGBl. I, p. 1966), most recently changed by the promulgation of January 3, 2022 (BGBl. I, p. 15)
StrlSchV		Ordinance on the Protection against the Harmful Effects of Ionising Radiation (Radiation Protection Ordinance - StrlSchV) Radiation Protection Ordinance of November 29, 2018 (BGBl. I, p. 2034, 2036), most recently changed by article 1 of the ordinance dated October, 2021 (BGBl. I p. 4645)
SiAnf	(2015-03)	Safety Requirements for Nuclear Power Plants (SiAnf) of November 22, 2012, amended version of March 3, 2015 (BAnz AT 30.03.2015 B2), most recently changed as promulgated by BMUV on February 25, 2022 (BAnz AT 15.03.2022 B3)
Interpret of SiAnf	(2015-03)	Interpretations of the safety requirements for nuclear power plants of November 22, 2012, of November 29, 2013 (BAnz AT 10.12.2013 B4), changed on March 3, 2015 (Banz AT of March 30, 2015 B3)
KTA 1202	(2017-11)	Requirements for the testing manual
KTA 1505	(2022-11)	Suitability verification of the stationary measurement equipment for radiation monitoring
DIN EN 1822-1	(2019-10)	High efficiency air filters (EPA, HEPA and ULPA) - Part 1: Classification, performance testing, marking; German version EN 1822-1: 2009
DIN ISO 2889	(2012-07)	Sampling airborne radioactive materials from the stacks and ducts of nuclear facilities (ISO 2889:2010)
DIN EN ISO 11929-1	(2011-01)	Determination of the characteristic limits (decision threshold, detection limit and limits of the coverage interval) for measurements of ionizing radiation - Fundamentals and application – Part 1: Elementary applications (ISO 11929-1:2019); German version EN ISO 11929-1:2021
KTA-GS 82	(2016-11)	Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for nuclear radiation measurements according to DIN ISO 11929 - Application examples for the KTA safety standard series 1500, Revision 1