

Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 1507 (2022-11)

**Monitoring the Discharge of Radioactive Substances
from Research Reactors**

(Überwachung der Ableitungen radioaktiver Stoffe bei
Forschungsreaktoren)

The previous versions of this safety
standard were issued in 1998-06, 2012-11 and 2017-11

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

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Monitoring the Discharge of Radioactive Substances from Research Reactors

KTA 1507

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PLEASE NOTE: Only the original German version of this safety standard represents the joint resolution of the 35-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in the Federal Gazette (Bundesanzeiger) on July 25, 2023. Copies of the German versions of the KTA safety standards may be mail-ordered through the Wolters Kluwer Deutschland GmbH (info@wolterskluwer.de). Downloads of the English translations are available at the KTA website (<http://www.kta-gs.de>).

All questions regarding this English translation should please be directed to the KTA office:

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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, the Radiation Protection Act (StrlSchG) and the Radiation Protection Ordinance (StrlSchV).

(2) The stationary and mobile radiation protection instrumentation has, among others, the dual purpose of protecting persons inside and outside of the plant from ionizing radiation and of verifying the specified normal functioning of the equipment for

- a) retaining solid, liquid and gaseous radioactive substances inside the designated enclosures,
- b) handling and the controlled conduction of radioactive substances within the plant, and
- c) monitoring the discharge of radioactive substances.

Safety standard series KTA 1500 specifies detailed safety related requirements regarding this radiation protection instrumentation.

(3) The present safety standard KTA 1507 contains the requirements that apply to the technical equipment and the supplementary administrative measures that are considered necessary for monitoring the discharge of radioactive substances with air and water in research reactors during specified normal operation and in the case of design basis accidents.

(4) Monitoring the discharge of radioactive substances contributes to meeting the requirements of Sec. 8 StrlSchG, and Secs 99, 102 and 103 StrlSchV, which specifically specify that it must be ensured

- a) that any exposure or contamination of man and environment is minimized and, even if below the respective limits specified in StrlSchG, is kept as low as possible taking into account the state of the art and all circumstances of the individual case (Sec. 8 para. 2 StrlSchG),
- b) that no unmonitored discharge of radioactive substances into the environment will occur (Sec. 99 para. 4 StrlSchV, and
- c) that discharges are monitored and reported to the proper authority at least once a year, specifying their kind and activity (Sec. 103 para. 1 StrlSchV). The corresponding monitoring equipment must meet the requirements of Sec. 90 StrlSchV.

(5) The tasks of monitoring the discharge of radioactive substances comprises

- a) the detailed assessment of the discharged radioactive substances, thus providing a basis for evaluating the radiological effects, and
- b) the automatic initiation of alarm signals.

(6) In addition to meeting the requirements of this safety standard, the federal Water Resources Act (WHG) and the water act of the respective federal State (*Bundesland*) shall also be fulfilled.

(7) When discharging waste water into a public sewage system, the individual requirements and restrictions specified in communal statutory law shall be taken into consideration.

1 Scope

(1) This safety standard shall apply to the equipment and facilities used for monitoring the discharge of gaseous sub-

stances, substances bound to aerosol particles and liquid radioactive substances from stationary research reactors with a power larger than 50 kW during specified normal operation and in the case of design basis accidents including the discharge from all plant components included in the nuclear license.

Note:

Examples for such plant components are neutron conductors, cold and hot neutron sources and irradiation facilities.

(2) In the case of mobile research reactors or research reactors with a power less than or equal to 50 kW and of zero power reactors, e.g. training reactors and critical assemblies, the present safety standard should be applied only to the extent that is reasonable taking all circumstances of the individual case into account.

(3) Whenever liquid radioactive substances are delivered to authorized third parties, e.g., central decontamination facilities or State collection facilities, the monitoring of these substances is not subject to the requirements of the present safety standard.

Note:

Secs. 85 and 94 StrlSchV pertain specifically to the transfer of radioactive substances.

2 Definitions

(1) Bleed water

Bleed water is that portion of the circulating coolant that is discharged from the secondary and tertiary cooling circuits in order to keep the amount of substances contained in the coolant within permissible limits.

(2) Discharge of radioactive substances

The discharge of radioactive substances is the intentional release of liquid radioactive substances, radioactive substances bound to aerosol particles or gaseous radioactive substances from the plant along designated paths.

(3) Discrimination of measurement equipment

The discrimination of measurement equipment is the ratio of the displayed value of the measurement parameter and the actual value of this measurement parameter.

(4) Specified normal operation

Specified normal operation comprises

- a) operating processes for which the plant, assuming the able function of all systems (fault free condition), is intended and suited (normal operation);
- b) operating processes which occur as a cause of a malfunctioning of plant components or systems (fault condition), insofar as safety related reasons do not stand in the way of continuing operation (abnormal operation);
- c) maintenance procedures (inspection, servicing, repair).

(5) Detailed assessment of radioactive substances

The detailed assessment is a special form of monitoring consisting of identifying, and determining the activity of, the radionuclides or radionuclide groups discharged over a given time span. For detailed assessment measured value is used. The measurement uncertainty is indicated separately.

(6) Cesium-137 equivalent (water)

Cesium-137 equivalent is a calculated measurement parameter in units of Becquerel per cubic meter (Bq/m³). It is determined

by multiplying the measured gamma count rate of a measurement source with a ratio of activity concentration and gamma count rate determined under the same geometric conditions for a standard solution of Cesium-137.

Note:

The measurements, both of the measurement source and of the Cesium-137 standard solution, are performed with a similar measuring equipment, the same measurement arrangement and similar radiation sources and the same gamma ray energy ranges.

(7) Double determination

Double determination is the activity measurement on aliquot portions of a representative sample after having performed identical preparatory procedural steps on these portions (e.g., concentration by evaporation, radio-chemical separation).

(8) Decision threshold

The decision threshold is a calculated value of a parameter (e.g., activity, activity concentration, specific activity) for the comparison with a measurement value in order to decide whether the parameter has contributed to the measurement or has had a zero effect.

Note:

- (1) Decision thresholds are determined in accordance with DIN EN ISO 11929-1.
- (2) Application examples are given in report KTA-GS 82.

(9) Research reactor

A research reactor is a nuclear reactor which is operated exclusively for at least one of the following purposes:

- a) utilization of the radiation produced by nuclear fission,
- b) measurement of nuclear physics data, or
- c) measurement of reactor physics data.

(10) Total alpha activity

The total alpha activity is the radioactivity determined by an integral measurement of the alpha particles emitted by a radioactive substance which is, then, related to the reference nuclide used for calibrating the measurement equipment.

(11) Total beta activity

The total beta activity is the radioactivity determined by an integral measurement of the beta particles emitted by a radioactive substance which is, then, related to the reference nuclide used for calibrating the measurement equipment.

(12) Overall dissipation factor (sampling airborne substances)

The overall dissipation factor is a correction factor to be applied to the determined discharge of airborne radioactive substances. It is, essentially, comprised of factors from changes of the activity concentrations of airborne radioactive substances arising from

- a) a determination in a partial air stream with a sampling rake,
- b) a non-isokinetic sampling,
- c) transport through the sampling pipe (pipe factor), and
- d) the transport in the accumulating and measurement equipment.

(13) Calibration of the measurement equipment for radiation monitoring

The calibration of the measurement 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.

(14) Measurement medium

The measurement medium is a sample taken from the medium to be monitored that – possibly after an engineering procedural treatment such as heating, filtration, dilution – flows through the measurement volume (i.e., that region for which the discrimination of the respective measurement equipment was determined during calibration).

(15) Mixture sample

A mixture sample is a mixture of individual samples or cumulative samples, or of parts of these samples, taken within a specified time period.

(16) Detection limit

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

Note:

- (1) Decision thresholds are determined in accordance with DIN EN ISO 11929-1.
- (2) Application examples are given in report KTA-GS 82.

(17) Representative sample (of discharges)

A representative sample is a particular sample the examination of which allows determining the discharged radioactive substances according to their kind and activity.

(18) Pipe factor

The pipe factor is the ratio – determined in a stationary condition – of the activity concentration of a radionuclide or radionuclide group at the entry port of a sampling probe and the activity concentration at the connection point of the accumulating or measurement equipment for monitoring the activity concentration of gaseous radionuclides or radionuclides bound to aerosol particles.

(19) Cumulative sample

A cumulative sample is a sample accumulated by continuous or quasi-continuous sampling within a specified time period.

(20) Threshold value

A threshold value is a plant-internal value the exceedance of which would require taking certain measures.

(21) Design basis accident

A design basis accident is a chain of events which, upon its occurrence, would require interruption of plant operation or of a task activity for reasons of safety, and which shall be considered in the plant design or for which, with regard to the task activity, protective measures shall be provided.

(22) Monitoring

Monitoring is a collective term for all different types of a controlled determination of physical parameters and includes comparing the results with specified values.

Notes:

- (1) Monitoring is performed
 - a) by continuous measurements or
 - b) by analyses of samples (e.g. in a laboratory) or

c) by a combination of measurement values and always in connection with the comparison of the results with specified values of the physical parameters (e.g., licensed limit values, operational values).

(2) To verify compliance with licensed limit values the upper limit of the probabilistically symmetric coverage interval is applied.

(23) Coverage interval

The coverage interval contains the area of potential true values of the measurand based on available information with a specified probability.

Note:

The limits of the probabilistically symmetric coverage interval are determined in accordance with DIN EN ISO 11929-1.

3 Monitoring the Radioactive Substances Discharged with Vent Air during Specified Normal Operation

3.1 General Requirements

(1) The radioactive substances discharged during specified normal operation shall be determined according to kind and activity in accordance with the requirements specified in this Section 3. With regard to the accumulation and measurement procedures, the following nuclides and nuclide groups shall be differentiated between:

- radioactive noble gasses,
- radionuclides bound to aerosol particles,
- radioactive gaseous iodine,
- tritium,
- radioactive strontium,
- alpha emitters, and
- carbon-14.

(2) With regard to monitoring the discharge of radioactive substances, the continuous or non-continuous sampling, the measuring and the accumulating of samples shall normally be performed in a partial air stream of the vent air. The volumetric flow of all partial air streams shall be continuously monitored.

(3) The volumetric flow of the vent air shall be measured and recorded continuously; the measurement uncertainty of the volumetric flow measurement shall be specified.

(4) With regard to the continuous measurement of radionuclides bound to aerosol particles and radioactive gaseous iodine, a deviation by more than 20 % of the volumetric flow of the partial air stream from its nominal value shall set off an alarm in the control room.

(5) Regarding the detailed assessment of radionuclides bound to aerosol particles, radioactive gaseous iodine, tritium, radioactive strontium, carbon-14 and other alpha emitters, the volumetric flow shall be measured and a deviation by more than 20 % of the volumetric flow of the partial air stream from its nominal value shall set off an alarm in the control room. This requirement may be dispensed with if piston pumps are used.

3.2 Radioactive Noble Gasses

3.2.1 Continuous measurement

(1) The radioactive noble gasses discharged with vent air shall be continuously determined by beta-measurements and shall be continuously monitored with respect to a threshold value. This requires at least one continuous measurement and recording of the total beta activity concentration in connection with the continuous measurement and recording of the volumetric flow of vent air.

(2) In order to prevent any falsification of measurement 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 measurement equipment.

(3) The detection limit of the measurement equipment for determining the activity concentration shall not exceed $1 \times 10^4 \text{ Bq/m}^3$ with respect to xenon-133 for a measurement duration of ten minutes.

(4) Taking the volumetric flow of vent air into account, the upper end of the measurement range shall be such that, relative to the vent air volume discharged in a 24 h period, it is possible to determine discharge rates at least up to one tenth of the licensed annual limit value.

(5) If the design of the activity measurement equipment does not provide for redundancy, the activity discharge from radioactive noble gasses shall be estimated for the duration of any outage duration of this measurement equipment; given a known volumetric flow of vent air, the estimation shall be based on some other permanently installed instrumentation. The outage duration may not exceed a time period of 3 days.

3.2.2 Detailed assessment

(1) The radioactive noble gasses discharged with vent air shall be subjected to a detailed assessment. This requires that a beta measurement is performed to determine the discharge rate of the total beta activity specified under Section 3.2.1 para. 1 taking the proportion of each individual nuclide in the nuclide composition into account.

(2) The non-continuous determination of the nuclide composition shall be performed on single representative samples taken in quarterly intervals. These samples shall be analyzed without delay. In this context, the radionuclides listed in **Table 3-1** shall be taken into account.

Radionuclides	
Argon-41	Xenon-131m
Krypton-85	Xenon-133
Krypton-85m	Xenon-133m
Krypton-87	Xenon-135
Krypton-88	Xenon-135m
	Xenon-138

Table 3-1: Radionuclides to be taken into account in the detailed assessment of the activity of radioactive noble gasses discharged with vent air

(3) The detection limit for the determination of the individual nuclides specified in para. 2 shall not exceed a value of $1 \times 10^3 \text{ Bq/m}^3$ with respect to xenon-133. Any undetected nuclides of **Table 3-1** shall be listed with the corresponding value of the decision thresholds and detection limits achieved in the individual measurements with the measurement equipment.

(4) If the measurement specified in para. 2 detects xenon-133 with an activity concentration exceeding $1 \times 10^3 \text{ Bq/m}^3$, however no krypton-85, then, after a decay period of at least two days, a second analysis of the sample shall be performed with regard to determining the activity concentration of krypton-85.

(5) In addition to sampling in quarterly intervals, further representative samples shall, without delay, be taken and analyzed if the threshold value specified in Section 3.2.1 para. 1 is reached and registers for the duration exceeding 30 minutes. For as long as this threshold value continues to register, a sample shall be taken at least every 24 hours and its nuclide composition determined without delay.

(6) In the case of non-continuous sampling, the nuclide composition shall be assumed as being constant in the interim period between two consecutive samplings and at the level of the second measurement.

(7) As an alternative to the requirements specified under paras. 2 through 6, the activity of discharged radioactive noble gases may also be determined by continuous nuclide-specific measurements. The detailed assessment shall be based on the nuclide spectra determined in daily intervals. When evaluating the daily nuclide spectra, the detection limit of the measurement equipment shall not exceed a value of $1 \times 10^3 \text{ Bq/m}^3$ for xenon-133.

(8) Any additional radioactive noble gas nuclides verified in the stack discharge shall individually be recorded in the report form (cf. **Figure 8-1**) under the heading "Other noble gases".

3.3 Radionuclides Bound to Aerosol Particles

3.3.1 Continuous measurement

(1) The radionuclides bound to aerosol particles discharged with vent air shall be monitored continuously. This requires that the radionuclides bound to aerosol particles shall be continuously accumulated from a partial air stream by deposition on a high-efficiency particulate air filter of at least Filter Class E12 in accordance with DIN EN 1822-1; the activity of the high-efficiency particulate air filter shall be measured during accumulation. From this measurement value the activity concentration shall be determined and shall be documented.

(2) The measurement equipment shall be designed such that, assuming a previously uncontaminated high-efficiency particulate air filter and a short-time exposure to a cesium-137 equivalent with a time integral of $4 (\text{Bq/m}^3) \times h$, the detection limit for the display of the measurement parameter "Activity on the filter" or "Increase of activity on the filter" will be exceeded in no more than one hour.

Note:

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

(3) The high-efficiency particulate air filter shall be monitored for an activity level the exceedance of which would indicate that the filter must be exchanged. At this level it shall still be possible at a nominal volumetric flow of the vent air and a corresponding filter loading to be able to detect a discharge of $5 \times 10^7 \text{ Bq}$ within one hour with a measurement uncertainty of less than 20 %.

(4) If the design of the measurement equipment for monitoring the discharge of radionuclides bound to aerosol particles does not provide for redundancy, the respective discharge shall be estimated for the duration of any outage duration of this measurement equipment; given a known volumetric flow of vent air, the estimation shall be based on some other permanently installed instrumentation, e.g., for monitoring the room atmosphere. The outage duration may not exceed a time period of 3 days.

(5) The requirement for a continuous measurement may be dispensed with, provided,

- a) the radionuclides bound to aerosol particles are retained by filtering the entire vent air with high-efficiency particulate air filters of at least Filter Class E12 in accordance with DIN EN 1822-1 and the functional capability of the retaining equipment is monitored, or
- b) a continuous measurement of the activity discharge from radioactive gaseous iodine is performed as specified in Section 3.4.1.

3.3.2 Detailed assessment

(1) The activity of radionuclides bound to aerosol particles discharged with vent air shall be subjected to a detailed as-

essment. This requires that these substances are continuously accumulated by deposition on a high-efficiency particulate air filter of at least Filter Class E12 in accordance with DIN EN 1822-1.

(2) The accumulation period shall not exceed one week; the time elapsed between start of accumulation and start of measurement shall be accounted for by applying a corresponding correction for radioactive decay.

(3) The high-efficiency particulate air filters shall be analyzed by gamma spectrometric measurements within two days after removal of the filter. In this context, the radionuclides listed in **Table 3-2** shall be taken into account.

(4) The high-efficiency particulate air filter specified under para. 1 shall be analyzed without delay whenever the threshold value specified under Section 3.2.1 para. 1 is reached and has registered for the duration of more than 30 minutes.

(5) The detection limit of the measurement equipment for determining the activity concentration shall not exceed $3 \times 10^{-2} \text{ Bq/m}^3$ with respect to cesium-137. Any undetected radionuclides of **Table 3-2** shall be listed with the value of the decision thresholds and detection limits achieved in the individual measurement with the measurement equipment.

Radionuclides	
Chromium-51	Silver-110m
Manganese-54	Antimony-124
Cobalt-58	Antimony-125
Iron-59	Iodine-131
Cobalt-60	Cesium-134
Zinc-65	Cesium-137
Zirconium-95	Barium-140
Niobium-95	Lanthanum-140
Ruthenium-103	Cerium-141
Ruthenium-106	Cerium-144

Table 3-2: Radionuclides to be taken into account in the detailed assessment of the activity of radionuclides bound to aerosol particles discharged with vent air

(6) Any additional radionuclides bound to aerosol particles verified in the stack discharge shall individually be recorded in the report form (cf. **Figure 8-1**) under the heading "Other γ -radiating radionuclides" or "Other α -emitting radionuclides".

3.4 Radioactive Gaseous Iodine

3.4.1 Continuous measurements

(1) The radioactive gaseous iodine discharged with vent air shall be monitored continuously. This requires that the radioactive iodine is continuously accumulated from a partial air stream on an iodine filter and that the filter is measured during accumulation for the deposited activity of iodine-131 (reference nuclide). The activity concentration shall be determined from this measurement value and shall be recorded.

(2) The measurement equipment shall be designed such that, assuming a previously uncontaminated iodine filter and a short-time exposure to iodine-131 with a time integral of $2 (\text{Bq/m}^3) \times h$, the display of the measurement parameter "Activity on the filter" or "Increase of activity on the filter" will exceed the detection limit in no more than one hour.

Note:

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

(3) The iodine filter shall be monitored for an activity level the exceedance of which would indicate that the filter must be exchanged. At this level it shall still be possible at a nominal volumetric flow of vent air and a corresponding filter loading to be able to detect a discharge of 1×10^6 Bq within one hour with a measurement uncertainty of less than 20 %.

(4) In order to prevent any falsification of the measurement values, a high-efficiency particulate air filter of at least Filter Class E12 in accordance with DIN 1822-1 shall be installed upstream of the iodine filter.

(5) Separation efficiency and loading capacity of the filters shall be taken into account both for elementary iodine and for organically bound iodine when choosing the sorption materials. The iodine sorbents used shall be characterized by a low adsorption for noble gasses.

Note:

The separation efficiency with respect to organically bound iodine is usually determined using methyl iodide as reference substance.

(6) If low licensed limit values prevent performing a continuous measurement of the discharge of iodine-131 with the measurement equipment specified under paras. 1 through 5, application of a plant-specific monitoring procedure is permissible.

3.4.2 Detailed Assessment

(1) The radioactive gaseous iodine discharged with the vent air shall be subjected to a detailed assessment. This requires that the radioactive gaseous iodine is accumulated by continuous deposition on an iodine filter.

(2) Separation efficiency and loading capacity of the iodine filters shall be taken into account both for elementary iodine and for organically bound iodine when choosing the filters.

(3) In order to prevent any falsification of the measurement 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 iodine filter; this high-efficiency particulate air filter may be the same one as the one specified under Section 3.3.2

(4) The accumulation period shall not exceed one week; the time elapsed between start of accumulation and start of measurement shall be accounted for by applying a corresponding correction for radioactive decay.

(5) The activity of iodine-131 shall be determined by gamma spectrometric measurements within one day after taking the sample.

(6) The high-efficiency particulate air filter and the iodine filter shall be analyzed without delay whenever the threshold value specified under Section 3.2.1 para. 1 is reached and has registered for the duration of more than 30 minutes.

(7) With regard to the detailed assessment of the activity of radioactive iodine, the detection limit of the measurement equipment shall not exceed 2×10^{-2} Bq/m³ with respect to the reference nuclide iodine-131.

(8) The detailed assessment of the activity of discharged radioactive iodine shall, preferably, be carried out as specified in paras. 1 through 7. Alternatively, it may be carried out as specified in paras. 9 through 13, provided, one, that the activity concentration of iodine-131 in the primary cooling circuit is less than 1×10^5 Bq/m³ and, two, that emissions not accounted for by this procedure, e.g., from experiments, are verified as being negligibly small.

(9) With regard to determining the discharged activity of iodine, representative water samples of the primary cooling circuit shall be taken in weekly intervals.

(10) The activity of iodine-131 in the representative water samples shall be determined by gamma spectrometric measurements within one day after the samples were taken. A corresponding correction for radioactive decay shall be applied.

(11) The detailed assessment of the radioactive iodine discharged with stack vent air shall basically be performed by multiplying the determined activity concentration of radioactive iodine in the primary cooling circuit by one-tenth (typical for research reactors) of the primary coolant volume that has evaporated during the period analyzed in the detailed assessment. It is permissible, alternatively, to base this detailed assessment of the radioactive iodine discharged with stack vent air on an experimentally determined coefficient accounting for the transfer of radioactive iodine from the primary cooling circuit to the stack vent air.

(12) Whenever the threshold value under Section 3.2.1 para. 1 is reached and has registered for the duration of more than 30 minutes, representative water samples from the primary cooling circuit shall, without delay, be taken and analyzed.

(13) The detection limit of the measurement equipment for performing the measurement specified under para. 10 shall, when performing the measurement on a sample of demineralized water, not exceed a value of 4×10^3 Bq/m³ for the reference nuclide iodine-131.

(4) Additionally iodine isotopes detected in the vent stack exhaust air in addition to iodine-131 shall be reported individually in the report form (cf. **Figure 8-1**) under "Other α -emitting radionuclides".

3.5 Tritium

3.5.1 Light water reactors

(1) The activity discharge of tritium with vent air in the chemical form of water shall be monitored. This requires continuously accumulating air samples.

(2) The samples shall be analyzed for the activity of tritium in quarterly intervals. This analysis may be carried out on the individual samples specified under para. 1 or on a representative mixture sample.

(3) The analysis procedure shall be able to detect a tritium activity concentration as low as 1×10^3 Bq/m³ in the vent air.

(4) If the type of sampling requires that the temperature and humidity of the vent air must be taken into account, then these parameters shall be determined in monthly intervals.

(5) If molecular sieves are used to collect tritium, then a possible falsification of the measurement results by residual activity shall be taken into account. Once used molecular sieves should not be used a second time. However, if repeated use is intended, then, prior to deployment, the used molecular sieve shall be cleared of any residual water and shall be reactivated by subjecting it to a four hour long rinsing process in a stream of inert gas at a temperature of 400 °C.

(6) As an alternative to the requirements specified under paras. 1 through 5, the procedure described under paras. 7 through 9 may be used.

(7) With regard to the detailed assessment of the activity discharge of tritium, the activity concentration of tritium in the pool water shall be measured once a year.

(8) The activity discharge from tritium shall be calculated by multiplying the activity concentration of tritium determined for the sample with the amount of annually evaporated pool water.

(9) The detection limit for the measurement of the activity concentration of tritium in the pool water shall not exceed a value of 4×10^4 Bq/m³.