Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 1504 (2022-11)

Monitoring and Assessing the Discharge of Radioactive Substances with Water

(Überwachung der Ableitung radioaktiver Stoffe mit Wasser)

The previous versions of this safety standard were issued in 1978-06, 1994-06, 2007-11, 2015-11 and 2017-11

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KTA SAFETY STANDARD

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Previous versions of the present safety standard: 1978-06 (BAnz No. 189a of October 6. 1978)
1994-06 (BAnz No. 238a of December 20, 1994)
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Comments by the Editor:

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

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

Basic Principles

(1) The safety standards of the Nuclear Safety Standards Commission (KTA) have the 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) The permanently installed and mobile radiation protection instrumentation, among other objectives, serves to protect the persons inside and outside of the facility from ionizing radiation, and to ascertain the specified normal functioning of the equipment

a) for keeping solid, liquid and gaseous radioactive substances within the intended enclosure,
b) for the handling and controlled conduction of radioactive substances within the facility, and
c) for monitoring and assessing the discharge of radioactive substances.

The safety standards in the KTA 1500 series specify concrete safety related requirements for this instrumentation.

(3) The present safety standard KTA 1504 details the requirements that apply to the technical equipment and the supplementary administrative measures considered necessary for the monitoring and assessment of the discharge of radioactive substances with water during specified normal operation and when design basis accidents occur.

(4) Monitoring and assessing the discharge of radioactive substances with water contributes to meeting the requirements of Sec. 8 StrlSchG, and Secs 99, 102 and 103 StrlSchV which specify that measures are taken such that

a) any exposure or contamination of persons and the environment – taking due account of the state of science and technology and considering the conditions of each individual case – are kept as low as possible even below the values specified in StrlSchG (Sec. 8 para. (2)),
b) any uncontrolled discharge of radioactive substances into the environment is prevented (Sec. 99 para. (4) of StrlSchV), and
c) the discharge is monitored and assessed, and its type and quantity of activity is reported to the proper authority at least once a year (Sec. 103 para. (1) of StrlSchV). The associated monitoring and assessment assemblies are subject to the requirements of Sec. 90 of StrlSchV.

(5) The monitoring and assessment of the discharge of radioactive substances with water must fulfil the following tasks:

a) the detailed assessment of the radioactive substances discharged with water as a basis for the evaluation of the radiological effects,
b) the automatic initiation of alarm signals.

(6) The equipment of the licensee required for performing the tasks under para. (5) are divided into

a) stationary measuring equipment and
b) mobile measuring equipment needed for performing the detailed assessment.

Note:

These are, e.g., nuclide-specific alpha emitter and gamma ray measuring stations, total-alpha and total-gamma measuring stations as well as scintillation measuring stations for liquids, and automatic sample extraction assemblies.

(7) In addition to meeting the requirements of the present safety standard, the Federal Water Act (WHG) and the individual water act of the respective State (*Bundesland*) shall also be fulfilled.

(8) When discharging waste water into a public sewage system, the pertaining requirements and prohibitions under local statutory law shall be observed.

1 Scope

This safety standard applies to the equipment and facilities for monitoring and assessing the discharge of radioactive substances with water from nuclear power plants with light water reactors during specified normal operation and when design basis accidents occur.

Notes:

(1) The requirements of in the present safety standard regarding stationary measuring equipment take into consideration that both, during specified normal operation and when design basis accidents occur, the radioactive substances are discharged in a controlled way. In the case of a failure of containers, of components and connecting pipe lines, the escaping water will either be held back in vessel-shaped compartments or are collected via drainage systems in sumps, drip pans or vessels such that, when a design basis accident happens, no immediate discharge to the environment will occur. It is, therefore, not necessary to correlate the content of this safety standard with the categories of accident survey display or wide range display.

(2) The requirements concerning nuclear power plants with pressurized water reactors (PWR) apply to those plants with U-tube steam generators.

2 Definitions

(1) Discharge of radioactive substances

The discharge of radioactive substances is the intentional release of liquid, aerosol-bound or gaseous radioactive substances from the facility along the paths designated for this purpose.

(2) Specified normal operation

The 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 in the event of a plant component or system malfunction (fault condition), insofar as safety related reasons do not stand against continued operation (abnormal operation);
c) maintenance procedures (inspection, servicing, repair).

(3) Detailed assessment of radioactive substances

The detailed assessment is a special form of monitoring and assessing that consists of identifying and determining the activity of the radionuclides or radionuclide groups discharged over a specified time span. The detailed assessment is based on the actual measurement value. The uncertainty is stated separately.

(4) Cesium-137 equivalent (water)

The Cesium-137 equivalent is a derived measurement quantity in units of Bq/m^3. It is calculated by multiplying a measured gamma count rate of the measurement source with the ratio of the activity concentration and the gamma count rate of a Cesium-137 standard solution determined under similar conditions.

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, similar radiation sources and the same gamma ray energy ranges.

(5) Decision measurement

A decision measurement in accordance with the present safety standard is a measurement of the activity concentration or of the Cesium-137 equivalent of representative water samples (cf. definition (12)) performed in a measurement laboratory by the licensee under his own responsibility regarding the decision on the discharge of radioactive substances with water.

(6) Decision threshold

The decision threshold is a calculated value of a physical quantity (e.g., activity, activity concentration, specific activity) that is compared with a measurement value to help decide whether the measured quantity is realistic or is merely a background effect.

Notes:

(1) The decision thresholds are determined in accordance with DIN EN ISO 11929-1.

(2) Examples for the determination of the characteristic limits are given in Status Report KTA-GS 82.

(7) Release

The release of radioactive substances is the unintentional leakage of radioactive substances from the intended enclosures into the facility or the environment.

(8) Calibration of a measuring equipment for radiation monitoring and assessment

Calibration of a measuring equipment for the radiation monitoring and assessment consists of determining the relationship between a measurement quantity as a fixed value of reference standards (e.g., activity of the calibration source) and the displayed value (e.g., count rate)

(9) Stationary measuring equipment

Stationary measuring equipment - in the sense of this term's usage in safety standards KTA 1501, KTA 1502, KTA 1503.1 to KTA 1503.3, KTA 1504 and KTA 1507 – are characterized in that

a) they are permanently installed,
b) they are tied into the instrumentation and controls and into the power supply system, and
c) their measurement signals are displayed and recorded in the control room.

(10) Mixture sample

A mixture sample is a uniform mixture of the individual or cumulative samples or of parts of these samples extracted over a specified time span.

(11) Detection limit

The detection limit is a calculated value of a physical quantity (e.g., activity, activity concentration, specific activity) that is compared with a specified reference value in to order to determine whether the measurement procedure is suited for the measurement purpose.

Notes:

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

(2) Examples for the determination of the characteristic limits are given in Status Report KTA-GS 82.

(12) Representative sample (water)

A representative sample is one the examination of which permits determining the type and quantity of radioactive substances discharged with water.

Note:

Principally, any mass-proportional or time-proportional extraction of samples may be considered as being representative. The latter, however, may only be considered representative if a correlation between the extracted samples and the medium being monitored or assessed exists for all operating conditions in accordance with the operating manual of the respective power plant.

(13) Cumulative sample

A cumulative sample is a sample created by a continuous or near-continuous extraction over a specified time span.

Note:

A week is established as being the time span between Monday, 0:00 hours and the following Sunday, 24:00 hours.

A month is established as being the time span of the successive weeks falling entirely or predominantly into the individual calendar month.

A quarter year is established as being the time span of the calendar quarter year under consideration of the definitions of week and month cited above.

A year is established as being the time span of the calendar year under consideration of the definitions of week, month and quarter year cited above.

(14) Switching threshold

The switching threshold of a measuring equipment is that value of a physical quantity (e.g., activity concentration) which, when exceeded, causes a switching procedure to be automatically executed.

(15) Threshold limit

The threshold limit is plant-specific value which, when exceeded, calls for the taking of certain measures.

(16) Design basis accident

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

(17) Monitoring and assessment

Monitoring and assessment collectively indicate any kind of a controlled measurement of physical quantities including the comparison of the results with specified values.

Notes:

(1) Monitoring and assessment consists of, e.g.,

a) a continuous measurement or
b) an analysis of samples (e.g., in the measurement laboratory) or
c) a correlation of measurement values

and, in each case, comparing the results with values specified for the physical quantities (e.g., license values, operational values).

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

(18) 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 Measurement Objects and Measurement Procedures

N o t e :

Appendix A and **Appendix B** are exemplary illustrations showing the systems to be monitored and assessed together with the respective measuring equipment and sample extraction locations.

3.1 Water Bodies and Associated Systems to be Monitored and Assessed

Radioactive substances shall be measured and assessed in the following water bodies and associated systems, unless radioactive discharges can be avoided by the design and the operation of the nuclear power plant.

(1) Radioactively contaminated waste waters

Discharge tank of the system for discharging waste water from the controlled area.

(2) Auxiliary service water

Open system for cooling the nuclear intermediate cooling circuits which may be radioactively contaminated.

(3) Waste water from the turbine building

System for discharging the waste water from the water or steam circuit and the operational waste water from the turbine building.

N o t e :

This includes, e.g. in PWRs, the backwash or regeneration water from the condensate and blowdown demineralizing systems, and, e.g. in BWRs, the water from the coolant drainage pool.

(4) Auxiliary steam system

System for supplying consumers in the nuclear and conventional areas with heating steam.

(5) Circulating water

System for cooling the turbine condensers.

(6) Receiving water discharge

System for discharging cooling water from the re-circulation cooling systems.

(7) Additional plant-specific paths

A detailed assessment of the activity discharges shall be prepared for the additional plant-specific paths unless these meet the insignificance criterion specified under Section 3.8.

3.2 Radioactively Contaminated Waste Water

3.2.1 Sample extraction

Prior to any discharge, a water sample shall be extracted that is representative for the entire content of the waste water discharge tank, and that is suited for the decision measurement and preparation of mixture samples (cf. **Appendix C**). For this purpose, the entire content of the tank shall be homogenized, e.g., by closed-loop pumping, by agitating or stirring. The duration of homogenizing should be adapted to the vessel size and should continue for at least 30 minutes. Prior to extracting the sample, the sample extraction line shall be flushed with the homogenized water. Beginning with the start of homogenization until the end the discharge procedure no water may be led into the waste water discharge tank. One liter of the sample shall be used for the decision measurement specified under Section 3.2.2 and shall be safely stored as evidential sample for the duration of one year (one-liter sample). Other parts shall be used to prepare mixture samples proportional in size to the respective discharges during a week, quarter year or year to be used for the detailed assessment (cf. **Appendix C**) and to prepare monthly mixture samples for determining the Tritium content as specified under Section 3.2.4.5.

3.2.2 Decision measurement

The decision about a discharge from the waste water discharge tank shall be based on the Cesium-137 equivalent of the one-liter sample and shall be determined by an integral measurement of the gamma radiation in the energy range above 60 keV.

3.2.3 Discharge

The water from the waste water discharge tank may be pumped off only if the value of the Cesium-137 equivalent does not exceed $2 \cdot 10^7$ Bq/m^3 and a written release by a duly authorized person has been issued. During the discharge, the activity concentration of the waste water shall be continuously monitored by a measuring equipment for the integral gamma radiation. Whenever the Cesium-137 equivalent exceeds $2 \cdot 10^7$ Bq/m^3 or a failure of the measuring equipment occurs this shall be displayed and recorded in the main control room; the discharge shall be automatically discontinued.

3.2.4 Detailed assessment

In the detailed assessment, the uncertainties arising during sample extraction and processing as well as the uncertainties from the measurement and analysis procedures shall be taken into consideration.

N o t e :

The requirements for the detection limits specified below apply to the respective measurement and analysis procedures on water samples.

3.2.4.1 Gamma ray emitters

Within the week following their preparation, the individual weekly mixture samples shall be subjected to gamma-spectrometric analyses. At a minimum, the radionuclides listed in **Table 3-1** shall be considered. The detection limit of the measuring equipment for determining activity concentrations shall not exceed $1 \cdot 10^3$ Bq/m^3 for Cobalt-60 when measuring a sample of demineralized water. The measurement duration for the detailed assessment shall be at least long enough to achieve the specified detection limit for Cobalt-60. Within the framework of the gamma-spectrometric analyses it shall be checked whether additional radionuclides not listed in **Table 3-1** are plant-specifically present in the waste water. If any are detected, only those radionuclides with a half-life longer than 8 days need to be considered in the detailed assessment.

Radionuclides	
Chromium-51	Silver-110m
Manganese-54	Tellurium-123m
Cobalt-57	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 3-1: Gamma ray emitting radionuclides to be considered in the detailed assessment

3.2.4.2 Radioactive strontium

Within the month following their preparation, the quarter-annual mixture samples shall be analyzed for their content of Strontium-89 and Strontium-90. The detection limit of the procedure for determining the activity concentration shall not exceed $5 \cdot 10^2$ Bq/m^3.

3.2.4.3 Alpha emitters

Within the month following their preparation, the quarter annual mixture samples shall be analyzed for their content of alpha emitters (total alpha activity). The detection limit of the procedure for determining the total alpha activity concentration shall not exceed $2 \cdot 10^2$ Bq/m^3 for Americium-241. If the examination of the sample shows an total alpha emitter activity concentration higher than $1 \cdot 10^3$ Bq/m^3, the sample shall be examined for the content of individual alpha emitters. The radionuclides listed in **Table 3-2** shall be considered. The detection limit of the procedure for determining the activity concentrations shall not exceed 50 Bq/m^3 for Americium-241. In the detailed assessment, it is permissible to consider the radionuclide pair Plutonium-329 and Plutonium-240 as one.

Radionuclides	
Plutonium-238	Americium-241
Plutonium-239	Curium-242
Plutonium-240	Curium-244

Table 3-2: Alpha emitting radionuclides to be considered in the detailed assessment

3.2.4.4 Iron-55 and Nickel-63

Within the quarter year following their preparation, the annual mixture samples shall be analyzed for their content of Iron-55 and Nickel-63. The detection limit of the procedure for determining the activity concentration shall not exceed $2 \cdot 10^3$ Bq/m^3.

3.2.4.5 Tritium

Within the month following their preparation, the monthly mixture samples shall be analyzed for their content of Tritium. The detection limit of the procedure for determining the activity concentration shall not exceed $4 \cdot 10^4$ Bq/m^3.

3.2.4.6 Correction for radioactive decay

The activity concentration of the radionuclides determined in the detailed assessment measurements of the mixture samples shall be corrected to the middle of the individual collection time spans using the respective half-life values of the radionuclides.

3.3 Service Water

3.3.1 Monitoring and assessment

(1) The monitoring and assessment of the discharge of activity shall be carried out indirectly by monitoring and assessing the activity concentration of the Cesium-137 equivalent in the nuclear intermediate cooling circuits and by monitoring and assessing the make-up feed volume of demineralized water in the nuclear intermediate cooling circuits. To this end,

a) a continuously operating and integrally measuring gamma ray measuring equipment shall be installed in each of the nuclear intermediate cooling circuits;

b) the make-up feed volume of demineralized water required to cover the water losses from each of the nuclear intermediate cooling circuits shall be determined and recorded in daily intervals. Demineralized water volumes that provably have not been mixed into the intermediate cooling water do not have to be taken into consideration;

c) a sample shall be extracted every month from each of the nuclear intermediate cooling circuits and shall be analyzed for its Tritium content.

(2) In case the cooling water of the generator cooling circuit is contaminated with Tritium, a sample shall be extracted every month and shall be analyzed for its Tritium content.

(3) In case the service water is introduced directly into a water body, the procedures specified under Sections 3.6.1, 3.6.2 and 3.6.4 shall be followed.

3.3.2 Securing of evidence

With respect to securing of evidence, a cumulative sample of at least one liter shall be extracted over the course of each week by automatically functioning equipment from the re-circulated service water before this is mixed with any other waters; each of these samples shall be safely stored for the period of one year.

3.3.3 Detailed assessment

(1) A weekly sample shall be extracted from the respective nuclear intermediate cooling circuits if the factorial product of Cesium-137 equivalent and make-up feed volume of demineralized water is larger than or equal to $4 \cdot 10^6$ Bq/d. If the factorial product of Cesium-137 equivalent and make-up feed volume of demineralized water is larger than or equal to $4 \cdot 10^8$ Bq/d, then the samples shall be extracted on a daily basis. These sample***s*** shall be subjected to a gamma- spectrometric analyses as specified under Section 3.2.4.1 within the week following their extraction.

Note:

Any simultaneously occurring leakages of the nuclear coolers and intermediate component cooling circuits can also be detected by the Tritium measurement specified under Section 3.3.1 item c).

(2) A monthly mixture sample shall be prepared from the samples extracted under para. (1) and, within the month following its preparation, shall be analyzed for its Strontium-89 and Strontium-90 content as specified under Section 3.2.4.2, for its alpha emitter content as specified under Section 3.2.4.3, and for its Tritium content as specified under Section 3.2.4.5.

(3) The activity concentrations of the radionuclides in the samples shall be converted to the middle of the individual collection time spans using the respective half-life values of the radionuclides; the resulting values shall, then, be multiplied with the make-up feed volume of demineralized water determined as specified under Section 3.3.1 para. (1) item b) for the respective collection time span.

(4) These examinations shall be performed observing the requirements for the detection limits as specified under Section 3.2.4.

3.3.4 Failure of a gamma ray measuring equipment

In the case of failure of a gamma ray measuring equipment of the nuclear intermediate cooling circuits, a one-liter sample shall be extracted daily and the Cesium-137 equivalent of this sample determined by an integral measurement of the gamma radiation in the energy range above 60 keV. If this measurement indicates that the factorial product of Cesium-137 equivalent and make-up feed volume of demineralized water is larger than or equal to $4 \cdot 10^6$ Bq/d, a detailed assessment of the activity as specified under Section 3.3.3 shall be performed.

3.4 Waste Water from the Turbine Building

3.4.1 Turbine building waste water from nuclear power plants with pressurized water reactors

3.4.1.1 Monitoring and assessment

(1) Monitoring and assessment of the activity discharge shall be performed indirectly by measuring the Cesium-137 equivalent in the steam generator blowdown system by means of continuously operating and integrally measuring gamma ray measuring equipment.

(2) A sample shall be extracted monthly from the water of the secondary cooling system and shall be analyzed for its Tritium content.

(3) Operational regulations shall be established to ensure that no water with an total activity concentration that exceeds $2 \cdot 10^7$ Bq/m^3 is discharged from the turbine building.

3.4.1.2 Securing of evidence

With respect to securing of evidence, flow-rate-proportional cumulative samples, or mixture samples proportional to the discharge quantity shall be prepared on a weekly basis from the turbine building waste water before the waste water is mixed into any other water bodies. One liter of each of these samples shall be safely stored for the period of one year.

3.4.1.3 Detailed assessment

(1) Whenever the monitoring and assessment specified under Section 3.4.1.1 indicates a Cesium-137 equivalent that exceeds $4 \cdot 10^5$ Bq/m^3, an additional part of the cumulative or mixture sample specified under Section 3.4.1.2 shall be subjected to a gamma-spectrometric analysis. From these samples accumulated within a single month, a discharge-mass proportional mixture sample shall be prepared and, in the month following its preparation, analyzed for its content of Strontium-89 and Strontium-90 as specified under Section 3.2.4.2. In the month following their preparation, the monthly mixture samples shall be examined for their content of alpha emitters as specified under Section 3.2.4.3 and Tritium as specified under Section 3.2.4.5.

(2) Whenever the monitoring and assessment specified under Section 3.4.1.1 para. (2) indicates a Tritium-specific activity concentration that exceeds $1 \cdot 10^6$ Bq/m^3, a detailed assessment of the discharge of Tritium shall be performed.

(3) The activity concentrations of the samples shall be converted to the middle of the individual collection time spans using the associated half-life values of the radionuclides; the resulting values shall, then, be multiplied with the volume of waste water from the turbine building in the respective collection time span.

(4) These examinations shall be performed observing the requirements for the detection limits as specified under Section 3.2.4.

3.4.1.4 Failure of a gamma ray measuring equipment in the steam generator blowdown system

In the case of failure of a gamma ray measuring equipment in the steam generator blowdown system, a one-liter sample shall be extracted daily from the respective blowdown train, and the Cesium-137 equivalent of this sample shall be determined by an integral measurement of the gamma radiation in the energy range above 60 keV. If this measurement indicates a Cesium-137 equivalent that exceeds $4 \cdot 10^5$ Bq/m^3, a detailed assessment of the activity as specified under Section 3.4.1.3 shall be performed.

3.4.1.5 Monitoring and assessment of the activity discharge from the turbine building sump during plant shutdown

(1) During plant shutdown, flow-rate-proportional daily cumulative samples or discharge-proportional daily mixture samples shall be extracted from the turbine building sump, and their Cesium-137 equivalent shall be determined without delay by an integral measurement of the gamma radiation in the energy range above 60 keV. If this measurement indicates a Cesium-137 equivalent that exceeds $4 \cdot 10^4$ Bq/m^3, a detailed assessment of the activity discharge as specified under Section 3.2.4.1 shall be performed.

(2) A permissible alternative to para. (1) is monitoring and assessing the activity discharge by measuring the Cesium-137 equivalent by means of continuously operating and integrally measuring gamma ray measuring equipment. If this measurement indicates a Cesium-137 equivalent that exceeds $4 \cdot 10^4$ Bq/m^3, the procedure specified under para. (1) shall be applied.

3.4.1.6 Condensate demineralizing system

The water from the condensate demineralizing system accumulated during backwash or regeneration and subsequent flushing shall be examined prior to any discharge. To this end, a representative sample shall be extracted and analyzed as specified under Section 3.2.2 in a measurement laboratory. If the Cesium-137 equivalent of this sample exceeds $2 \cdot 10^6$ Bq/m^3, the entire charge shall be directed to the facilities for processing radioactively contaminated water. If the Cesium-137 equivalent is smaller than or equal to $2 \cdot 10^6$ Bq/m^3, the water may be discharged directly without prior treatment. Basically, a detailed assessment of the discharges shall be performed as specified under Section 3.2.4. A detailed assessment of the discharges is not required if the value for the Cesium-137 equivalent is smaller than $4 \cdot 10^4$ Bq/m^3.

3.4.1.7 Blowdown demineralizing system

The water accumulated from the blowdown demineralizing system during backwash or regeneration and subsequent flushing shall be examined prior to any discharge. To this end, a representative sample shall be extracted and analyzed as specified under Section 3.2.2 in a measurement laboratory. If the Cesium-137 equivalent exceeds $2 \cdot 10^6$ Bq/m^3, the entire charge shall be directed to the facilities for processing radioactively contaminated water. If the Cesium-137 equivalent is smaller than or equal to $2 \cdot 10^6$ Bq/m^3, the water may be discharged directly without prior treatment. Basically, a detailed assessment of the discharges shall be performed as specified under Section 3.2.4. A detailed assessment of the discharges is not required if the Cesium-137 equivalent is smaller than $4 \cdot 10^4$ Bq/m^3.

3.4.2 Turbine building waste water from nuclear power plants with boiling water reactors

(1) The turbine building is part of the controlled area. The turbine building waste water shall be diverted to the facilities for processing radioactively contaminated water; after processing, the waste water shall be dealt with as specified under Section 3.2.

(2) When water is discharged from the cooling water evacuation tank then, over a time span of up to one week, a flow-rate-proportional cumulative sample or a discharge-mass proportional mixed sample shall be extracted from the discharge pipe by means of automatic devices. The Cesium-137 equivalent shall be determined for a one-liter sample of these extractions by an integral measurement of the gamma radiation in the energy

range above 60 keV. If the Cesium-137 equivalent exceeds $4 \cdot 10^4$ Bq/m^3 the one-liter sample shall be analyzed as specified under Section 3.2.4.1, and a detailed assessment of the discharge shall be performed.

3.5 Auxiliary Steam System

3.5.1 Monitoring and assessment

Note:

Cf. **Appendix D** for additional details.

(1) To detect possible contaminations of an auxiliary steam system which also supplies nuclear systems, the Cesium-137 equivalent of the auxiliary steam condensate shall be monitored by means of a continuously operating and integrally measuring gamma ray measuring equipment.

(2) Whenever a specified activity concentration (the switching threshold) is exceeded at the measuring equipment specified under para. (1), the backflow of the auxiliary steam condensate from the controlled area shall automatically be discontinued and the auxiliary steam condensate shall be redirected to the facilities for processing radioactively contaminated water.

(3) The Cesium-137 equivalent of the switching threshold specified under para. (2) shall basically not exceed $2 \cdot 10^6$ Bq/m^3.

(4) If the Cesium-137 equivalent of a switching threshold exceeds $2 \cdot 10^5$ Bq/m^3 a sample shall be extracted from the auxiliary steam condensate three times a week, and the Cesium-137 equivalent of each sample shall be determined within a day of its preparation by an integral measurement of the gamma radiation in the energy range above 60 keV.

(5) Whenever the Cesium-137 equivalent of a sample specified under para. (4) exceeds $2 \cdot 10^5$ Bq/m^3 then, without delay, the backflow of the auxiliary steam condensate from the controlled area shall be discontinued and the auxiliary steam condensate redirected to the facilities for processing radioactively contaminated water.

(6) The auxiliary steam generator of boiling water reactors (BWR) shall be continuously monitored for leakages by a dose rate measuring equipment. Whenever an operationally specified switching threshold of this measuring equipment is exceeded, the main steam supply to the auxiliary steam generator and the secondary steam outlet shall be automatically discontinued.

(7) The switching threshold specified under para. (6) shall be adjusted such that a guillotine break of a heating pipe of the auxiliary steam generator (during full-power operation of the reactor plant) is covered.

3.5.2 Measures during steam extraction from an auxiliary boiler system outside of the controlled area

(1) Whenever a specified activity concentration (the switching threshold) at the measuring equipment for the auxiliary steam condensate specified under Section 3.5.1 para. (1) is exceeded, the backflow of the auxiliary steam condensate into the auxiliary feed water tank shall be automatically discontinued.

(2) The Cesium-137 equivalent of the switching threshold specified under para. (1) shall basically not exceed $2 \cdot 10^6$ Bq/m^3.

(3) Whenever the Cesium-137 equivalent of a switching threshold exceeds $2 \cdot 10^5$ Bq/m^3, then – deviating from the provisions of para. (4) – a daily sample shall be extracted and evaluated. Following the start-up and shutdown procedures of any system whose primary-side is charged with a radioactive medium, a sample shall be extracted without delay from the auxiliary steam condensate and shall be promptly evaluated. The Cesium-137 equivalent of these samples shall be determined by an integral measurement of the gamma radiation in the energy range above 60 keV.

(4) If the measurement location under para. (1) indicates a value larger than $4 \cdot 10^4$ Bq/m^3, a sample shall be extracted three times a week from the auxiliary steam condensate and, within a day, the Cesium-137 equivalent of each sample shall be determined by an integral measurement of the gamma radiation in the energy range above 60 keV.

(5) If the Cesium-137 equivalent of any sample under paras. (3) or (4) exceeds $4 \cdot 10^4$ Bq/m^3, the backflow of the auxiliary steam condensate into the auxiliary boiler feedwater tank shall be immediately discontinued.

(6) A sample shall be extracted from the auxiliary boiler system before any blow-down or draining procedures are performed. The Cesium-137 equivalent for this sample shall be determined by an integral measurement of the gamma radiation in the energy range above 60 keV.

(7) If the Cesium-137 equivalent of one of the samples as specified under para. (6) exceeds $2 \cdot 10^6$ Bq/m^3, the water from the auxiliary boiler system shall be redirected to the facilities for processing radioactively contaminated water. If the Cesium-137 equivalent is smaller than or equal to $2 \cdot 10^6$ Bq/m^3, the water may be discharged directly without prior treatment. The detailed assessment of the discharges shall be performed as specified under Section 3.2.4. A detailed assessment of the discharges is not required if the Cesium-137 equivalent is smaller than or equal to $4 \cdot 10^4$ Bq/m^3.

3.5.3 Failure of the gamma ray measuring equipment in the auxiliary steam condensate

(1) In the case of failure of the gamma ray measuring equipment specified under Section 3.5.1 para. (1), one sample shall be extracted and evaluated daily. Following the start-up and shutdown procedures of any system whose primary-side is charged with a radioactive medium, a sample shall be extracted without delay from the auxiliary steam condensate and shall be promptly evaluated. The Cesium-137 equivalent of these samples shall be determined by an integral measurement of the gamma radiation in the energy range above 60 keV.

(2) If the Cesium-137 equivalent of a sample specified under para. (1) exceeds $2 \cdot 10^5$ Bq/m^3, then, the backflow of the auxiliary steam condensate from the controlled area shall immediately be discontinued and the auxiliary steam condensate redirected to the facilities for processing radioactively contaminated water.

(3) In case of steam extraction from the auxiliary boiler system, the backflow of the auxiliary steam condensate into the auxiliary boiler feedwater tank shall be immediately discontinued if the Cesium-137 equivalent of a sample specified under para. (1) exceeds $4 \cdot 10^4$ Bq/m^3.

3.6 Circulating Water System

3.6.1 Continuous measurement

To detect, and then secure evidence of unintentional discharges, a continuously operating and integrally measuring gamma ray measuring equipment shall be installed in the circulating water outfall culvert, the circulating water outfall structure or at other water outfall locations.

3.6.2 Sample extraction, evaluation, and securing of evidence

(1) With respect to the securing of evidence, automatically operating equipment in the circulating water outfall culvert, in the circulating water outfall structure or at other discharge locations

shall extract a daily cumulative sample of at least on liter. The daily cumulative samples collected in one month shall be safely stored for one additional month. A monthly mixture sample shall be prepared from the daily cumulative samples of an individual month and shall be subjected to gamma-spectrometric analyses within the following month. One liter from each of the monthly mixture samples shall be safely stored for the duration of one year.

(2) In case of failure of the automatically operating sample extraction assemblies, daily mixture samples shall be prepared from random samples. These shall be processed and evaluated as specified under para. (1).

(3) The requirements regarding detection limits as specified under Section 3.2.4 shall be observed in these examinations.

(4) If the Cesium-137 equivalent at the measuring equipment specified under Section 3.6.1 exceeds $4 \cdot 10^5$ Bq/m^3, the respective daily cumulative sample specified under para. (1) or the daily mixture sample specified under para. (2) shall be immediately subjected to a gamma-spectrometric analysis. Additional samples shall be extracted and, likewise, be immediately subjected to gamma-spectrometric analyses. These daily mixture samples shall be safely stored for the period of one year.

Note:

Cf. Section 3.6.3 para. (2) for additional details.

3.6.3 Previous contamination of the receiving water source

(1) With respect to securing evidence of radioactive substances entering the nuclear power plant from the receiving water source, cumulative and mixture samples shall be extracted from the circulating water intake culvert or circulating water intake structure, shall be analyzed and safely stored as specified under Section 3.6.2.

(2) If the Cesium-137 equivalent at the measuring equipment specified under Section 3.6.1 exceeds $4 \cdot 10^5$ Bq/m^3, the daily cumulative sample shall immediately be subjected to a gamma-spectrometric analysis.

3.6.4 Failure of the gamma ray measuring equipment in the circulating water system

In the case of failure of the gamma ray measuring equipment in the circulating water system specified under Section 3.6.1, the Cesium-137 equivalent of the daily cumulative sample specified under Section 3.6.2 para. (1), or of the daily mixture sample specified under Section 3.6.2 para. (2), shall be determined by an integral measurement of the gamma radiation in the energy range above 60 keV. If the Cesium-137 equivalent exceeds $4 \cdot 10^5$ Bq/m^3, the sample shall be immediately subjected to a gamma-spectrometric analysis. Additional samples shall be extracted and, likewise, be immediately subjected to gamma-spectrometric analyses.

3.7 Receiving Water Discharge

Unless the receiving water discharge is monitored and assessed with the cooling water, the procedure as specified under Section 3.6 shall be applied.

3.8 Additional Plant-Specific Paths

(1) The specification of required monitoring and assessment measures regarding radioactive substances discharged along additional paths requires plant-specific knowledge of these possible additional paths. Therefore, all additional paths shall be considered along which radioactive substances can be discharged during specified normal operation or in the course of a design basis accident in such amounts that emission monitoring and assessment may not be dispensed with.

(2) The possibility of a activity discharge does not have to be assumed if at least two material barriers or one material barrier together with one pressure barrier lie between the system in question and the environment and one material barrier remains functional even under design basis accident conditions.

(3) No detailed assessment of the activity discharge during specified normal operation is required for those discharge paths whose activity discharge to the environment meets the insignificance criterion. This criterion is regarded as fulfilled if the activity that can be discharged to a receiving water source or culvert during specified operation in one week is less than that activity resulting from the factorial product of the average weekly waste water volume from the waste water discharge tanks (cf. Section 3.2) and the minimum allowed detection limits of the individual radionuclide groups specified under Sections 3.2.4.1 through 3.2.4.4.

(4) In the case of Tritium, the insignificance criterion is regarded as fulfilled if the activity concentration is less than $1 \cdot 10^6$ Bq/m^3.

4 Design of the Monitoring Equipment

4.1 General Requirements for Stationary Measuring Equipment

4.1.1 Design and installation

(1) The individual measuring equipment shall be designed as specified in **Table 4-1** with respect to the environmental and medium conditions as well as to the operating voltage range.

(2) The measured value shall not vary by more than ± 30% relative to the one achieved during calibration as specified under Section 5.2.1.2 whenever one influencing parameter varies within its nominal operating range as specified in **Table 4-1** and all other influencing parameters stay, as far as possible, unchanged near the reference values of the calibration.

(3) The reference values listed in **Table 4-1** shall be applied to the corresponding influencing parameters. The reference value for the background radiation shall be specified by the manufacturer of the measuring equipment.

(4) The detection limits shall be determined for an ambient dose rate of 0.25 µGy/h (Cesium-137).

Note:

The detection limits are determined in accordance with DIN EN ISO 11929-1.

(5) The design of equipment not installed in a measurement laboratory shall conform to the protection degree IP 54 in accordance with DIN EN 60529 (protection from foreign bodies and water).

(6) The measuring equipment shall be installed and placed such that

a) the nominal operating ranges cited in the corresponding equipment specifications are not exceeded,

b) testing, maintenance and repair can be easily performed,

(7) Measurement chambers and sample extraction vessels shall be designed to be removable, decontaminable and rinsible.

(8) Regarding the resistance of the measuring equipment against electromagnetic disturbances (e.g., electrostatic discharges, electromagnetic fields, interference voltages), the EMVG shall be complied with.

(9) Measuring equipment that are continuously in operation shall be connected to an emergency power supply.

(10) Measuring equipment that are continuously in operation shall be designed to be self-monitoring.

(11) After a power interruption, the measuring equipment specified under para. (9) shall restart automatically.

(12) Wherever measuring equipment are installed in a bypass, the flow through the bypass shall be monitored. In the case of those measuring equipment installed directly in a system, the flow of the measurement medium through the measuring equipment shall be monitored.

(13) Possible count rate losses within a measurement range of the measuring equipment (e.g. due to dead times) shall be known as a function of the count rate and shall be taken into consideration. A decreasing display for an increasing measurement quantity (overload) is not admissible.

4.1.2 Factors for the statistical confidence level

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

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

(3) The factor $k_{1-\gamma/2}$ in accordance with DIN EN ISO 11929-1 is equal to 1.645.

4.1.3 Adjustment of the energy threshold

It shall be ensured that the lower energy threshold under consideration of its fluctuations is adjusted such that all radionuclides with gamma ray energies larger than 100 keV are detected.

4.1.4 Threshold limits

(1) If a readjustment is required during operation of the equipment, built-in adjustment devices shall be provided. Any adjustment of the electronic instruments of the measurement, monitoring and assessment assemblies shall be placed or secured in such a way that a re-adjustment by unauthorized personnel is made largely impossible. A self-adjustment must be made entirely impossible.

(2) Failure of the equipment and threshold limits being exceeded shall be optically and acoustically displayed and recorded in the main control room. Collective alarms are permissible, provided, the measurement location is indicated in the control room or a control room annex. The acoustic alarms may be cancelled individually or collectively before their causes have been corrected.

(3) The optical signals in the main control room indicating an equipment failure or that upper threshold limits are exceeded shall be such that the specific alarm condition is recognizable.

4.1.5 Measured value display and recording

(1) The measurement devices shall normally have only one display range. If several display ranges are necessary, then

a) in the case of several linear display ranges, the measurement ranges shall overlap each other by at least 10 %, however, the difference between the scale end values may not differ by a factor larger than 10;

b) in the case of several logarithmic display ranges, the measurement ranges shall overlap each other by at least one power of ten.

(2) All measurement values shall normally be displayed on the measuring equipment themselves, and they shall be displayed and recorded in the main control room.

(3) The recordings shall be directly visible and well legible over a time span of three hours.

4.1.6 Testability

The measuring equipment shall be designed and constructed such that the correct functioning of the individual devices can be established within the framework of the initial tests specified under Section 5.2.1 and of the in-service inspections specified under Section 5.2.2. It shall be possible to carry out functional tests even while the nuclear power plant is in full power operation.

4.2 Specific Requirements for Stationary Measuring Equipment

Note:

An overview of the minimum measurement ranges, of the threshold limits and switching thresholds of the total gamma ray measuring equipment is presented in **Table 4-2**.

4.2.1 Detection limits

The detection limits as defined in Section 2 para. (11) of the continuous measuring equipment shall not be higher than the lower limit values of the minimum measurement ranges specified below.

4.2.2 Gamma ray measuring equipment in the discharge pipe of the discharge tank

(1) The measurement range of the gamma ray measuring equipment for the continuous monitoring of the Cesium-137 equivalent in the discharge pipe of the discharge tank shall extend at least from $4 \cdot 10^5$ Bq/m^3 to $4 \cdot 10^7$ Bq/m^3.

(2) Both events, that of the Cesium-137 equivalent exceeding $2 \cdot 10^7$ Bq/m³ and that of a failure of the measuring equipment shall automatically set off alarms and be recorded in the main control room. In these cases, the drain valve of the waste water discharge tank shall be automatically closed, and the feed pump shall be automatically shut down.

4.2.3 Gamma ray measuring equipment in the nuclear intermediate cooling circuits

The measurement range of the gamma ray measuring equipment for the continuous monitoring of the Cesium-137 equivalent in the nuclear intermediate cooling circuits shall extend at least from $4 \cdot 10^5$ Bq/m³ to $4 \cdot 10^7$ Bq/m^3. Both events, that of the Cesium-137 equivalent exceeding $4 \cdot 10^6$ Bq/m^3 and that of a failure of a measuring equipment shall set off alarms and be recorded in the main control room.

4.2.4 Gamma ray measuring equipment in the steam generator blowdown lines of pressurized water reactors

The measurement range of the gamma ray measuring equipment for the continuous monitoring of the Cesium-137 equivalent in the steam generator blowdown lines shall extend at least from $1 \cdot 10^5$ Bq/m^3 to $4 \cdot 10^6$ Bq/m^3. Both events, that of the value for Cesium-137 equivalent exceeding $4 \cdot 10^5$ Bq/m^{3}and that of the failure of a measuring equipment shall set off alarms and be recorded the main control room.

4.2.5 Measuring equipment in the auxiliary steam supply system

(1) The measurement range of the gamma ray measuring equipment for the continuous monitoring of the Cesium-137 equivalent in the condensate of the auxiliary steam supply system shall extend at least from $2 \cdot 10^4$ Bq/m^3 to $1 \cdot 10^7$ Bq/m^3. It is admissible to raise the lower value of the measurement range to 50 % of the switching threshold.

(2) Both events, that of a failure of the measuring equipment specified under para. (1) and that of the switching threshold specified under Section 3.5.1 para. (2) being exceeded shall set off alarms and be recorded in the main control room.

(3) In the case of steam extraction from an auxiliary boiler system outside of the controlled area, any event of the switching threshold specified under Section 3.5.2 para. (1) being exceeded shall set off an alarm and be recorded in the main control room.

(4) The measurement range of the measuring equipment specified under Section 3.5.1 para. (6) shall normally extend from 5 % to 200 % of the switching threshold specified under Section 3.5.1 para. (6).

(5) Both events, that of a failure of the measuring equipment specified under para. (4) and that of the switching threshold specified under Section 3.5.1 para. (6) being exceeded shall set off alarms and be recorded in the main control room.

4.2.6 Gamma ray measuring equipment in the circulating water outfall culvert or circulating water outfall structure

The measurement range of the gamma ray measuring equipment for the continuous measurement of the Cesium-137 equivalent in the circulating water outfall culvert or circulating water outfall structure shall extend from at least $1 \cdot 10^4$ Bq/m^3 to $2 \cdot 10^8$ Bq/m^3. Both events, that of the value for Cesium-137 equivalent exceeding $4 \cdot 10^5$ Bq/m^3 and that of a failure of the measuring equipment shall set off alarms and be recorded in the main control room.

4.2.7 Failure of the continuously operating gamma ray measuring equipment

In case of a failure of the continuously operating gamma ray measuring equipment for the continuous measurement of the Cesium-137 equivalent, the Cesium-137 equivalents of the samples specified under Sections 3.3.4, 3.4.1.4, 3.5.3 and 3.6.4 shall be performed with a gamma ray measuring equipment as specified in Section 4.3.4.

4.3 Specific Requirements for Mobile Measurement and Sample Extraction Assemblies

4.3.1 General requirements

(1) Suitable procedures and measuring equipment shall be available in the measurement laboratory for the analysis of the one-liter sample specified in Section 3.2.2 as well as for the mixture and cumulative samples.

N o t e :

To illustrate this text, **Appendix E** shows examples of the mobile measurement and sample extraction assemblies that are deployed within the framework of the present safety standard.

(2) The measurement and sample extraction assemblies shall be installed and placed such that

a) the nominal operating ranges cited in the corresponding equipment specifications are not exceeded,

b) testing, maintenance and repair can easily be performed,

(3) Measurement laboratories shall fulfill the quality assurance measures in accordance with safety standard KTA 1401.

(4) Measurement laboratories under contract to the licensee shall additionally submit suitable qualification certificates in accordance with the Guideline “Control of Self-Monitoring”.

4.3.2 Testability

The measurement and sample extraction assemblies shall be designed and constructed such that the correct functioning can be established as specified under Section 5.3. It shall be possible to carry out functional tests even while the nuclear power plant is in full power operation.

4.3.3 Factors for the statistical confidence level

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

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

(3) The factor $k_{1-\gamma/2}$ in accordance with DIN EN ISO 11929-1 is equal to 1.645.

4.3.4 Total gamma ray measuring equipment

(1) The measurement range of the gamma ray measuring equipment shall extend at least from $1 \cdot 10^4$ Bq/m^3 to $2 \cdot 10^8$ Bq/m^3 (Cesium-137 equivalent).

N o t e :

An overview of the minimum measurement ranges, of the threshold limits or switching thresholds of the total gamma ray measuring equipment is presented in **Table 4-2**.

(2) The detection limit as defined in Section 2 (11) of the measuring equipment under para. (1) shall not be higher than the lower limits of the respective minimum measurement ranges.

4.3.5 Assemblies for the analysis of individual nuclides

The requirements regarding the detection limits for gamma ray emitters as specified under Section 3.2.4.1 shall be observed.

4.3.6 Measuring equipment for discontinuous measurements of alpha particle and beta emitters

The requirements regarding the detection limits for alpha particle and beta emitters as specified under Section 3.2.4 shall be observed.

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 direct current grid	
Ambient temperature (°C)	15 °C to 40 °C	20 °C
Ambient air pressure (hPa)	900 hPa to 1100 hPa	Manufacturer specification
Relative humidity of ambient air	10 % to 95 %, non-dewing	60 %
Temperature of the measurement medium (°C)	10 °C to 60 °C	20 °C

Table 4-1: Nominal operating ranges and reference values for influence parameters

Monitored water	*Minimum measuring range (Cesium-137 equivalent)*	*Threshold limit or switching threshold (Cesium-137 equivalent)*
Continuous total gamma measuring equipment		
Waste water (discharge tank)	$4 \cdot 10^5$ Bq/m³ to $4 \cdot 10^7$ Bq/m³	$2 \cdot 10^7$ Bq/m³
Nuclear intermediate cooling circuit	$4 \cdot 10^5$ Bq/m³ to $4 \cdot 10^7$ Bq/m³	cf. Section 3.3
Sludge drain of the steam generator (waste water from the turbine building)	$1 \cdot 10^5$ Bq/m³ to $4 \cdot 10^6$ Bq/m³	$4 \cdot 10^5$ Bq/m³
Auxiliary steam condensate	$2 \cdot 10^4$ Bq/m³ to $1 \cdot 10^7$ Bq/m³	cf. Sections 3.5.1 and 3.5.2
Main cooling water (outlet)	$1 \cdot 10^4$ Bq/m³ to $2 \cdot 10^8$ Bq/m³	$4 \cdot 10^5$ Bq/m³
Discontinuous total gamma ray measuring equipment		
Waste waters (discharge tank/decision measurement)	$1 \cdot 10^4$ Bq/m³ to $2 \cdot 10^8$ Bq/m³	–
Other waters, cf. Section 4.3.4	$1 \cdot 10^4$ Bq/m³ to $2 \cdot 10^8$ Bq/m³	–

Table 4-2: Overview of the minimum measuring ranges, of the threshold limits or switching thresholds for total gamma ray measuring equipment

5 Maintenance of the Monitoring Equipment

Note:

Unless otherwise indicated, the requirements of this Section 5 apply to, both, the stationary and the mobile measuring equipment.

5.1 Servicing and Repairs

5.1.1 Performing servicing and repairs

Servicing and repairs of the measuring equipment shall be performed in accordance with the individual operating and repair instructions and only by qualified persons.

5.1.2 Documentation

All servicing and repair tasks performed shall be documented. The corresponding records shall contain the following information:

a) unambiguous identification of the measuring equipment,

b) type of the servicing or repair task performed,

c) type and number of replaced parts,

d) reasons for the replacement of parts,

e) for the newly installed parts: date and detailed description of the test certificates and of the test certificates required under the present safety standard,

f) information regarding outage times,

g) date of the servicing or repair,

h) names and signatures of the qualified persons.

5.2 Tests and Examinations for Stationary Measuring equipment

The stationary measuring equipment shall be subjected to the following tests and examinations:

a) prior to their deployment in a nuclear power plant:

  aa) certification of suitability,

  ab) calibration,

b) prior to their initial deployment in a specific nuclear power plant:

  ba) suitability check,

  bb) calibration check with calibration sources,

  bc) factory test,

  bd) commissioning test,

c) during deployment in the nuclear power plant

  ca) regularly recurrent in-service inspections,

  cb) tests and examinations after servicing and repair tasks.

5.2.1 Tests and examinations prior to the initial deployment in a nuclear power plant

5.2.1.1 Certification of suitability

(1) Prior to the initial deployment in a specific nuclear power plant, it shall be verified that the measuring equipment fulfill their tasks and that they meet the specified requirements.

Notes:

(1) Additional related requirements are specified in safety standard KTA 1505.

(2) The suitability certification comprises the (plant-specific) certification of the equipment characteristics and the plant-specific suitability check.

(2) The plant-specific certification shall be performed by the proper authority or by an authorized expert appointed by said authority.

5.2.1.2 Calibration and calibration check

(1) Prior to their initial deployment in a specific nuclear power plant, the measuring equipment specified under Section 4.2 shall be calibrated with a Cesium-137 calibration source. This calibration may be performed on type-identical equipment.

(2) The response of the measuring equipment for gamma radiation must be known for the energy range from 100 keV to 1700 keV; in the case of the dose rate measuring assemblies specified under Section 3.5.1 para. (6), the upper energy shall be equal to the gamma ray energy emitted by the decay of Nitrogen-16.

Note:

Regarding these dose rate measuring assemblies, their detection sensitivity to gamma rays emitted by the decay of Nitrogen-16 relative to the detection sensitivity to gamma rays in the energy range below 1 MeV can be improved by appropriate means, e.g. by proper shielding.

(3) During calibration, a set of calibration sources shall be specified which individually permit checking one display value in one of the lower and one display value in one of the upper decades of the measurement range, and which can later be used to re-calibrate other type-identical equipment.

(4) During the re-calibration of measuring equipment, a recalibration value shall be determined with a calibration source in a defined and reproducible geometry to enable later checks of the calibration.

5.2.1.3 Factory test

(1) A factory test shall be performed to certify proper manufacturing and perfect functioning of the monitoring and assessment assemblies.

(2) If the monitoring and assessment assemblies are composed of components from different manufacturers, the proper manufacturing and perfect functioning of these components shall be certified in the respective manufacturing plants.

(3) The factory test shall be performed as a routine test and shall encompass:

a) visual inspection,

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

c) test of the characteristic curve by means of an impulse or current generator with at least one test value per decade of the measurement range,

d) test of the overload capacity (electronically or by using a calibration source), and

e) calibration check by using a calibration source.

(4) The factory test shall be carried out by plant experts, and, in well-founded cases, in the presence of authorized experts appointed by the proper authority.

5.2.1.4 Commissioning test

(1) A post-installation commissioning test shall be performed to verify that the measuring equipment have been properly constructed and are in functional order. The following items shall be tested:

a) construction of the measuring equipment,

b) installation of the measuring equipment,

c) display (by at least one test value per decade of the measurement range),
d) calibration check (by using a calibration source),
e) setting of threshold limits, and signaling (alarms),
f) equipment failure alarm,
g) connection to the emergency power system,
h) automatic restart after interruption of the power supply,
i) flow monitoring,
k) measurement value processing,
l) supply of operating media.

Regarding item d), equality with the calibration specified under Section 5.2.1.2 para. (1) shall be verified.

(2) In case of digital measuring equipment, a set of reference parameters shall be specified.

(3) The commissioning test shall be carried out by the licensee and, to an extent specified by the proper authority, by said authority or its appointed authorized expert.

5.2.2 In-service inspections

5.2.2.1 General requirements

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

(2) It must be possible to perform the in-service inspections without interaction in the circuitry (e.g. soldering).

5.2.2.2 Regular in-service inspections

(1) Inspections shall be performed to verify the perfect functioning of the measuring equipment. The regular in-service inspections shall be based on the tests and examinations and the test frequencies listed in **Table 5-1**.

(2) The tests and examinations shall be carried out by the licensee and, to an extent specified by the proper authority, by said authority or its appointed authorized expert.

5.2.2.3 Tests after repairs

After repairs, the correct functioning shall be verified by a commissioning test as specified under Section 5.2.1.4 to an extent corresponding to the extent of the repairs.

5.2.2.4 Removal of defects

For the removal of defects, repair times and possible alternative measures shall be specified in the operating manual. The defects including the measures taken for their removal shall be documented.

5.3 Tests and Inspections of Mobile Measuring equipment

(1) It shall be verified that the measuring equipment fulfill their tasks and that they meet the requirements specified in the present safety standard.

(2) The measuring equipment shall be calibrated regarding their individual measurement task.

(3) A commissioning test shall be performed to verify that the measuring equipment have been properly constructed and are in functional order. The following items shall be tested:

a) construction of the measuring equipment,
b) placement of the measuring equipment,
c) Functionality and performed calibration check, and
d) supply of operating media.

(4) The commissioning test shall be carried out by the licensee and, to an extent specified by the proper authority, by said authority or by, or in the presence of, an authorized expert appointed by said authority.

(5) The test schedule, the test instructions and the test certificates shall be prepared in accordance with safety standard KTA 1202.

(6) Regular in-service inspections shall be performed to verify the perfect functioning of the measuring equipment. The inspections shall be based on the tests and examinations and the test frequencies listed in Running Numbers 2 and 7 of **Table 5-1.**

(7) After repairs, the correct functioning shall be verified to an extent corresponding to the extent of the repairs by a commissioning test.

<table>
<tr><th rowspan="2">Run-ning No.</th><th rowspan="2">Test Object</th><th rowspan="2">Testing Procedure</th><th colspan="2">Test Frequency</th></tr>
<tr><th>by the licensee</th><th>by the proper authority or an expert authorized by said authority</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Stationary measuring equipment</td><td>a) Visual inspection</td><td>during inspection rounds</td><td>–</td></tr>
<tr><td>b) Visual inspection
c) Calibration check with radiation source:
- response
- location of photo line in the energy spectrum (peak position)
d) Check of lower energy threshold</td><td>quarter annually</td><td>annually</td></tr>
<tr><td>2</td><td>Testing and mainte-nance records</td><td>Visual inspection</td><td>–</td><td>annually</td></tr>
<tr><td>3</td><td>Electronic subunits</td><td>Inputting suitable signals at preinstalled input jacks or simulating signals directly at the input of the measuring transducer with at least one value in each decade of the measuring range[1)] for the integral test of the measuring transducer.
To test the measuring transducer output as well as the logging equipment (such as displays, re-corders, monitoring computers), at least one value shall be simulated in each decade of the measuring range; in the case of computer-based measuring and monitoring equipment, the simu-lation may be performed by a keyboard-assisted computer program.
Comparison of all displays and logs
In the case of digital measuring equipment: com-parison of the preset parameters with the set of reference parameters</td><td>annually</td><td>annually</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Alarm signals</td><td>Operational readiness: visual inspection</td><td>during inspection rounds</td><td>annually</td></tr>
<tr><td>Failure alarm signals:
a) by interrupting the voltage supply, or
b) by interrupting the signal connection between measurement transducer and detector, or
c) by input of a value below the failure thresh-old,
d) in the case of digital measuring equipment: it suffices to test the signaling via the functions provided by the computer program, provided, the program is tested and is self-monitoring.</td><td>quarter annually</td><td>annually</td></tr>
<tr><td>Threshold signals: by radiation source or electrically</td><td>quarter annually</td><td>quarter annually</td></tr>
</table>

Table 5-1: Regular in-service inspections (Part 1)

Running No.	Test Object	Testing Procedure	Test Frequency by the licensee	Test Frequency by the proper authority or an expert authorized by said authority
5	Flow monitor and supply of operating media			
	without automatic function control	Visual inspection	during inspection rounds	annually
	with automatic function control	Visual inspection and comparison of the set point value with the actual value	quarter annually	annually
6	Automatic sample extraction assembly[2]	a) visual inspection	during inspection rounds	–
		b) function test	annually	annually
		c) checking failure thresholds	annually	annually
7	Mobile measuring equipment	a) visual inspection	quarter annually	annually
		b) calibration check	quarter annually	annually

[1] The testing procedure of simulating detector signals at the measuring transducer input for the integral test of the measuring transducer and measuring circuits – with at least one value per decade – is not required in the case of computer-based measuring equipment if the associated computer program has been qualified. In this case it is sufficient to insert a single signal in the uppermost decade of the measurement range, provided, the pre-processing electronics do not cause any switching procedures over the entire measurement range. Even this latter signal insertion is not required if the calibration check is carried out with one measurement value in the uppermost decade of the measurement range.

[2] As specified in Sections 3.3.2, 3.4.1.2 (for PWR), 3.4.2 para. (2) (for BWR), 3.6.2, 3.6.3 and, if applicable, Section 3.7.

Table 5-1: Regular in-service inspections (Part 2)

6 Measurement Results

6.1 Documentation

6.1.1 Flowchart

(1) The sample extraction and measuring equipment in the monitored systems used for the monitoring and assessment of radioactive substances discharged with water shall be graphically depicted in a clearly structured flowchart. Different symbols shall be used to identify the various sample extraction types and measurement types.

(2) The required measurement task and the measurement procedure for each sample extraction and measuring assembly shall be specified, e.g., in tabular form, and this description shall be correlated to the flowchart. The purpose, type, location and frequency as well as the required measurements shall be specified for the sample extractions. The measurement tasks and related technical requirements (e.g., the type of measurement, the measurement device including shielding, calibration, measurement ranges, detection limit and measurement uncertainty) shall be specified for the measuring equipment. Likewise, the measurement tasks and related technical requirements shall be specified for the measurement laboratory.

6.1.2 Extent of documentation

The documentation shall be conceived such that a comprehensive verification of the discharge of radioactive substances with water is possible. This includes records regarding:

a) activity measurements
(individual nuclide activity concentrations and discharge rates),

b) sample extractions
(continuous, discontinuous; point in time, time span),

c) water quantities
(amount, point in time, duration, water outfall location), and

d) persons in charge and persons executing the tasks.

6.2 Reporting to Proper Authority

6.2.1 Contents

The reports to the proper supervisory authority regarding the discharge of radioactive substances with water shall include:

a) quantity of water discharged,

b) licensed values,

c) nuclide-specific discharge of activity including their measurement uncertainties, and

d) the minimum and maximum identification limits achieved by the measuring equipment used in the time span covered by the report.

6.2.2 Detailed assessment

(1) The nuclide-specific verification of the activity discharged and a comparison with the licensed values shall be carried out both, quarter yearly and for the time span since the beginning of the year. The detailed assessment may exclude those radionuclides the concentrations of which are below the decision threshold achieved.

(2) If a detailed assessment is required for the service water and for the turbine building waste water as specified under Sections 3.3.3 or 3.4.1.3, separate report forms shall be issued.

6.2.3 Report forms

(1) The regular reporting shall normally be carried out using the report form specified in **Figure 6-1**.

(2) The entry of values in the column “Discharged Activity” shall be limited to those radionuclides where the measurement values of the activity concentration are above the decision threshold. If in the time span of the detailed assessment no measurement values were detected that exceed the decision threshold, the corresponding fields in the report form that are applied to calculate the discharged activity shall be marked as “n.n.” (none detected).

(3) The measurement uncertainties shall be summed up in accordance with the Gaussian error propagation, and the resulting value shall be entered at the appropriate line in the column „Discharged Activity and its Uncertainty”.

Report Form for the Discharge of Liquid Radioactive Substances		Page of
Power Plant:	Calendar Quarter:	Year:
Discharge of water:	Discharge tank	Other systems
in calendar quarter m³	Service cooling water	
since beginning of the year m³	Turbine building waste water	

Radionuclide	Decision Threshold or Detection Limit of Activity Concentration		Discharged Activity[4] and its Uncertainty		License Value	Remarks
	DT max.[1] (Bq/m³)	DL max.[1] (Bq/m³)	in calendar quarter (Bq)	since beginning of year (Bq)	(Bq/a)	
Cr-51						
Mn-54						
Fe-59						
Co-57						
Co-58						
Co-60						
Zn-65						
Zr-95						
Nb-95						
Ru-103						
Ru-106						
Ag-110m						
Te-123m						
Sb-124						
Sb-125						
I-131						
Cs-134						
Cs-137						
Ba-140						
La-140						
Ce-141						
Ce-144						
……….. [2]						
Sr-89						
Sr-90						
Fe-55 [3]						
Ni-63 [3]						
Sum β- + γ-emitters						
Total α-activity						
Pu-238						
Pu-239 + Pu-240						
Am-241						
Cm-242						
Cm-244						
Sum individual α-emitters						
Sum α- + β- + γ-emitters without H-3						
H-3						

[1] "DT max." and "DL max." are the maximum Decision Threshold and maximum Detection Limit that was reached in the individual measurement during the time span covered by the detailed assessment.

[2] Whenever applicable, other gamma emitters with a half-life longer than 8 days.

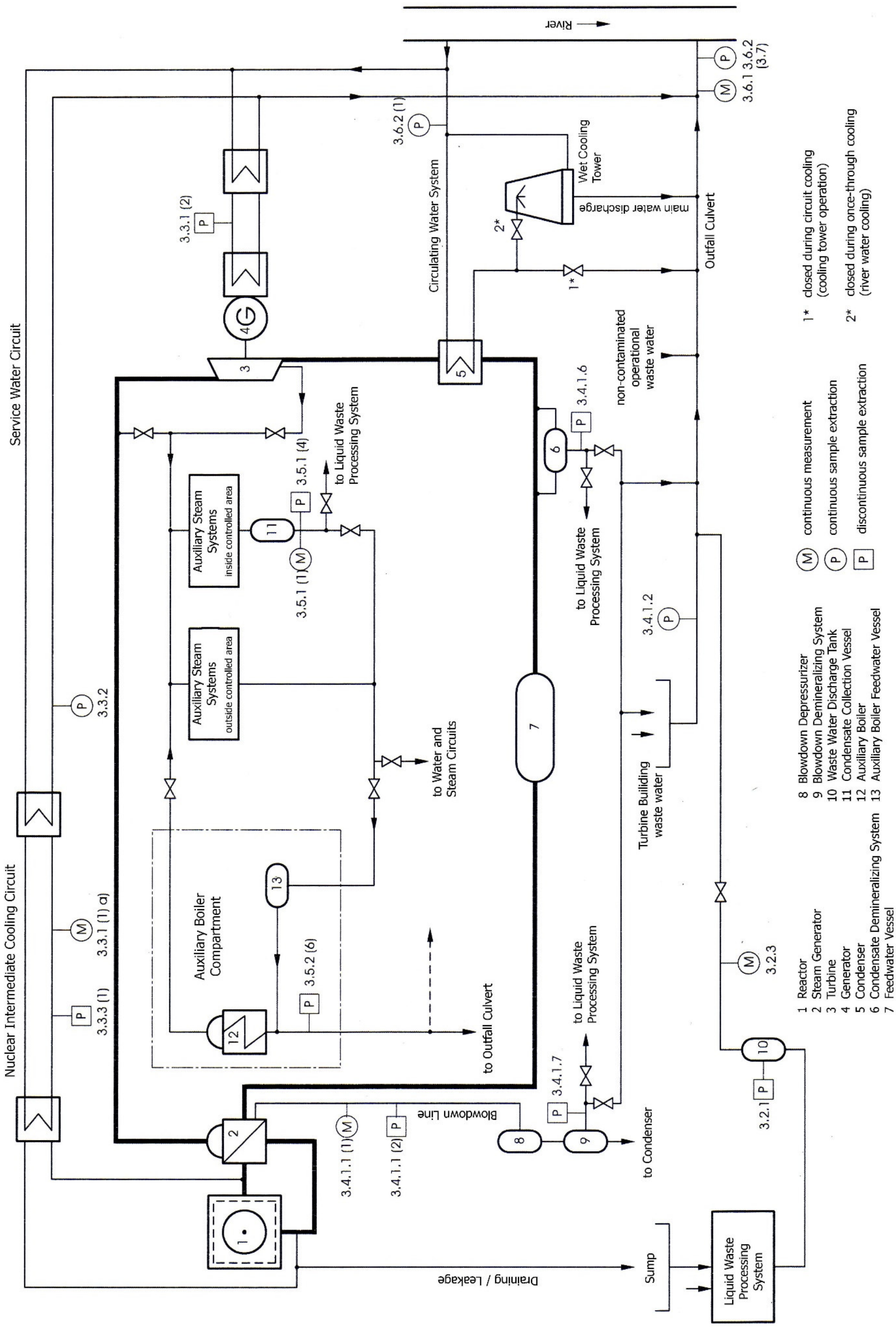
[3] Corresponding data are possibly omitted since the determination of the nuclides Fe-55 and Ni-63 in accordance with Section 3.2.4.5 is only carried out for yearly mixed samples

[4] "n.n." (non detected).

Table 6-1: Report forms for the discharge radioactive substances with water

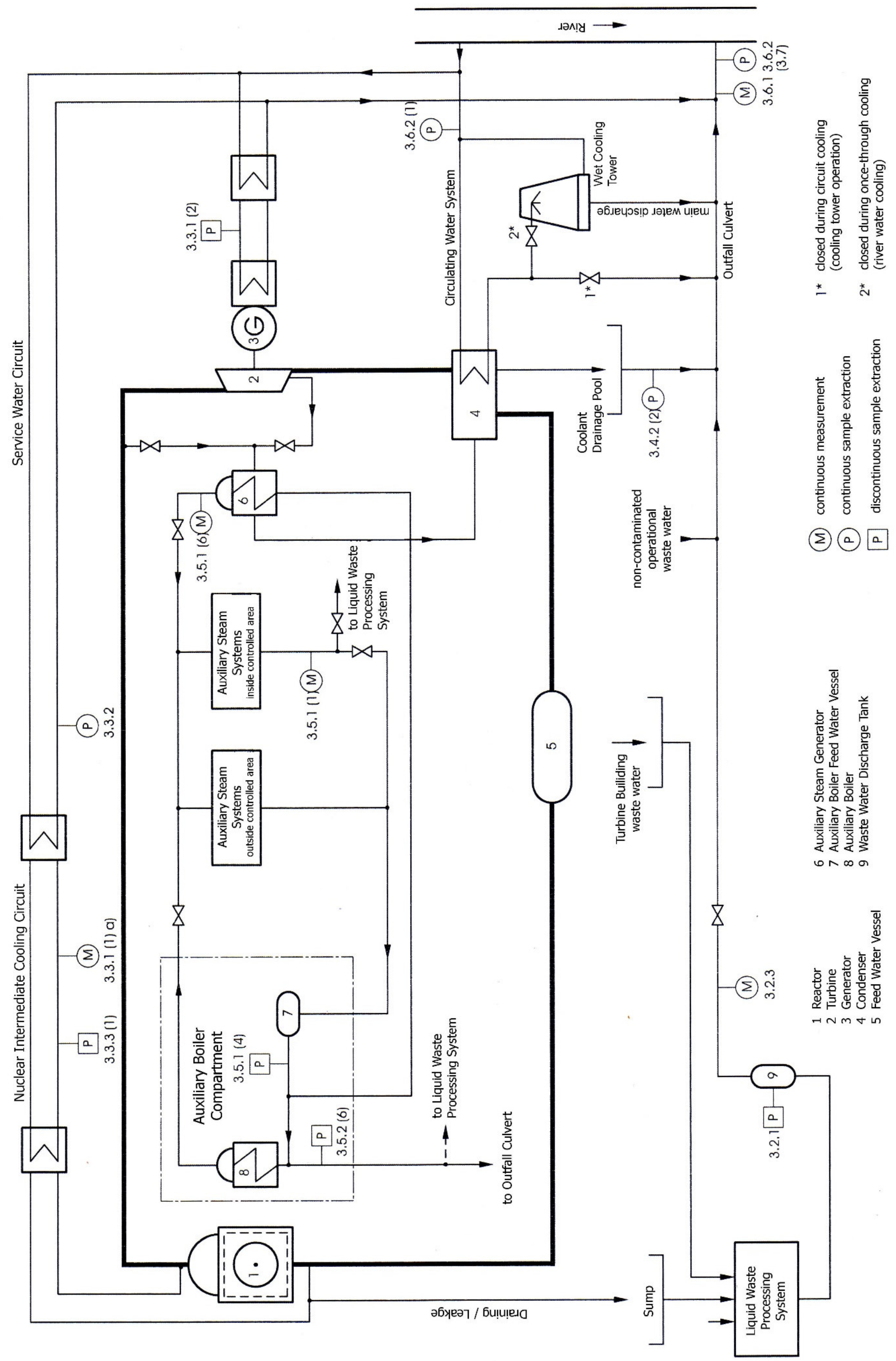
Appendix A (informative)

Example for Monitoring and Assessing Waste Water and Cooling Water Systems in Nuclear Power Plants with Pressurized Water Reactors



Appendix B (informative)

Example for Monitoring and Assessing Waste Water and Cooling Water Systems in Nuclear Power Plants with Boiling Water Reactors



Appendix C

Instruction for Preparing the Weekly, Monthly, Quarter-Annual and Annual Mixture Samples for the Detailed Assessment Measurements

C 1 General Requirements

For performing the detailed assessments, weekly, quarter-annual and annual mixture samples shall be prepared that are proportional to the discharge of waste water from the discharge tanks. In this context, first the weekly mixture samples are produced, and from these, in turn, the quarter-annual mixture samples and then the annual mixture samples.

C 2 Acidification and Carrier Solutions

The samples extracted from the waste water discharge tanks to produce the weekly mixture samples shall first be acidified; then, Carrier Solutions 1 and 2 (cf. **Table C-1**) shall be mixed in.

C 2.1 Acidification of the Samples

The samples from the discharge tanks shall be acidified by adding enough concentrated nitric acid such that the acidity lies between pH 1 and pH 2. The pH value shall be checked.

C 2.2 Carrier Solutions for the Samples

The Carrier Solution 1 is produced by dissolving the 13 compounds specified in **Table C-1** in 100 ml of hydrochloric acid (0.1 mol per liter). The Carrier Solution 2 is produced by dissolving the two compounds $SbCl_3 \cdot 6\,H_2O$ and tartaric acid in 100 ml water.

Carrier Solution 1		***Carrier Solution 2***	
Compound	**Mass in g**	**Compound**	**Mass in g**
1. $CrCl_3 \cdot 6\,H_2O$	2.0	1. $SbCl_3 \cdot 6\,H_2O$	1.1
2. $MnCl_2 \cdot 4\,H_2O$	1.4	2. Tartaric acid	4.0
3. $FeCl_3 \cdot 6\,H_2O$	1.9		
4. $CoCl_2 \cdot 6\,H_2O$	1.6		
5. $ZrOCl_2 \cdot 8\,H_2O$	1.4		
6. CsCl	0.5		
7. $BaCl_2 \cdot 2\,H_2O$	0.7		
8. $LaCl_3 \cdot 7\,H_2O$	1.0		
9. $CeCl_3 \cdot 7\,H_2O$	1.0		
10. $SrCl_2 \cdot 6\,H_2O$	1.2		
11. $YCl_3 \cdot 6\,H_2O$	1.3		
12. $ZnCl_2$	0.8		
13. $NiCl_2 \cdot 6\,H_2O$	1.6		

Table C-1: List of compounds for Carrier Solutions 1 and 2

Appendix D

Explanatory Remarks

Section 3.5.1 Monitoring and assessment

In pressurized water reactors, the activity discharge with the waste water from the turbine buildings is monitored and assessed indirectly, as specified under Section 3.4.1 1, by monitoring and assessing the steam generator blowdown by means of continuously operating and integrally measuring gamma ray measuring equipment. A detailed assessment is required, whenever the Cesium-137 equivalent in the steam generator blowdown exceeds $4 \cdot 10^5$ Bq/m^3 (cf. Section 3.4.1.3).

It is admissible to derive comparable indications of a possible activity discharge into the turbine building waste water by monitoring and assessing the auxiliary steam condensate. This would necessitate that a detailed assessment of the discharges with the turbine building waste water is also performed if the Cesium-137 equivalent in the auxiliary steam condensate being circulated back to the turbine building exceeds $4 \cdot 10^5$ Bq/m^3.

However, a corresponding requirement is not needed in the present safety standard because the measures specified under Section 3.5.1 ensure that any auxiliary steam condensate the Cesium-137 equivalent of which exceeds $2 \cdot 10^5$ Bq/m^3 is either not at all, or only briefly, circulated back into the turbine building.

Appendix E (informative)

Examples of Mobile Measurement and Sample Extraction Assemblies Deployed in Accordance with the Present Safety Standard

Measurement Objects	Task	Section	A	B	C	D	E	F
Radioactively Contaminated Waste Water	Sample extraction	3.2.1						
	Decision measurement (integral measurement of the gamma emitters)	3.2.2	x					
	Weekly mixture sample for determining activity concentrations, gamma emitters	3.2.4.1		x				
	Quarter-annual mixture sample for determining activity concentrations of Sr-89 and Sr-90	3.2.4.2			x			
	Quarter-annual mixture sample for determining activity concentrations of alpha emitters	3.2.4.3				x	a)	
	Annual mixture sample for determining activity concentrations Fe-55	3.2.4.4			x			
	Annual mixture sample for determining activity concentrations Ni-63	3.2.4.4			x			
	Monthly mixture sample for determining activity concentrations of Tritium	3.2.4.5			x			
Service Water	Monthly sample from intermediate cooling circuit for determining activity concentrations Tritium	3.3.1 c)			x			
	If generator cooling circuit contains Tritium, monthly sample determination	3.3.1 (2)			x			
	If introduced directly into a water body, cf. Section 3.6.1, 3.6.2 and 3.6.4	3.3.1 (3)		x				x
	Extract cumulative sample from the re-circulated service water	3.3.2						x
	Weekly sample and determination of activity concentration	3.3.3 (1)	x					
	Factorial total gamma ray ≥ $4 \cdot 10^8$ Bq/d, evaluation cf. Section 3.2.4.1	3.3.3 (1)		x				
	Determination of daily make-up feed volume of demineralized water	3.3.3 (1)						
	Monthly mixture sample for Tritium determination	3.3.3 (2)			x			
	Quarter annual mixture sample for Sr-89 and Sr-90 determination	3.3.3 (2)			x			
	Quarter annual mixture sample for determining activity concentrations of Alpha emitters	3.3.3 (3)				x	a)	
	Failure of a gamma ray measurement equipment: daily sample extraction and analysis	3.3.4	x					
Waste Water from Turbine Building (only PWR)	Monthly sample from secondary cooling circuit water for Tritium determination	3.4.1.1 (2)			x			
	Mass cumulative and flow proportional mixture samples on weekly basis	3.4.1.2						x
	If total gamma in the steam generator blowdown system > $4 \cdot 10^5$ Bq/m³:	3.4.1.3 (1)		x				
	monthly mixture sample for determining activity concentrations Tritium	3.4.1.3 (1)			x			
	monthly mixture sample for determining activity concentrations Sr-89 und Sr-90	3.4.1.3 (1)			x			
	Monthly mixture sample for determining activity concentrations Alpha	3.4.1.3 (1)				x		
	Failure of measuring equipment: daily sample extraction and analysis	3.4.1.4	x					
	Detailed assessment as specified under Section 3.4.1.3 if total gamma in blowdown train > $4 \cdot 10^5$ Bq/m³	3.4.1.4		x	x	x		
	During plant shutdown, daily cumulative sample and analysis	3.4.1.5 (1)	x					x
	Detailed assessment as specified under Section 3.2.4.1 if total gamma > $4 \cdot 10^4$ Bq/m³	3.4.1.5 (1)		x				
Condensate Demineralizing System	Evaluation of representative sample	3.4.1.6	x					
Blowdown Demineralizing System	Evaluation of representative sample	3.4.1.7	x					
	Detailed assessment as specified under Section 3.2.4 if total gamma is between $4 \cdot 10^4$ Bq/m³ and $2 \cdot 10^6$ Bq/m³	3.4.1.7		x	x	x		

a) If measurement at D > $1 \cdot 10^4$ Bq/m³ then additional measurement at E (Nuclide-specific alpha emitter measuring setup)

continued next page

Measurement Objects	Task	Section	A	B	C	D	E	F
BWR Turbine Building	Prepare weekly flow-rate-proportional cumulative sample or discharge-mass proportional mixed sample from cooling water evacuation tank	3.4.2 (2)						x
	Analyze weekly cumulative or mixture sample	3.4.2 (2)	x					
	If total gamma > $4 \cdot 10^4$ Bq/m³, examination as specified under Section 3.2.4.1	3.4.2 (2)		x				
Auxiliary Steam System	If total gamma > $2 \cdot 10^5$ Bq/m³, three samples per week and their analysis	3.5.1 (4)	x					
	if total gamma > $2 \cdot 10^5$ Bq/m³, daily samples and their analysis	3.5.2 (3)	x					
	if total gamma > $4 \cdot 10^4$ Bq/m³, three samples per week and their analysis	3.5.2 (4)	x					
	Prior to blow-down or draining procedures, sample extraction and analysis	3.5.2 (6)	x					
	Detailed assessment as specified under Section 3.2.4 if total gamma is between $4 \cdot 10^4$ Bq/m³ and $2 \cdot 10^6$ Bq/m³	3.5.2 (7)		x	x	x		
	Failure of measuring equipment: daily sample extraction and analysis	3.5.3 (1)	x					
Circulating Water System	Preparation of daily cumulative samples	3.6.2 (1)						x
	Preparation of monthly mixture sample and analysis	3.6.2 (1)		x				
	Failure of extraction equipment for daily cumulative samples: preparation of random daily mixture samples and their analysis	3.6.2 (2)		x				
	If total gamma assembly exceeds $4 \cdot 10^5$ Bq/m³, immediate analysis of daily mixture or daily random mixture samples and preparation and analysis of additional samples	3.6.2 (4)		x				
	Failure of gamma ray measuring assembly: analysis of daily mixture or daily random mixture samples	3.6.4	x	b)				
Receiving Source	Prepare daily cumulative and mixture samples	3.6.3 (1)		x				x
	If total gamma at measuring assembly specified under Section 3.6.1 exceeds $4 \cdot 10^5$ Bq/m³, immediate analysis of daily cumulative mixture sample	3.6.3 (2)		x				
Receiving Discharge	If applicable, procedure as specified under Section 3.6	3.7						

a) If measurement at D > $1 \cdot 10^4$ Bq/m³ then additional measurement at E

b) If measurement at A > $4 \cdot 10^5$ Bq/m³ then additional measurement at B

A Total gamma (Caesium-137 equivalent.)
B Gamma (Nuclide-specific)
C Beta (by liquid scintillation resp. proportional counter)
D Total alpha (Large area counter)
E Alpha (nuclide-specific)
F Automatic sample extraction assembly

Appendix F

Regulations Referred to in the Present Safety Standard

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

AtG		Act on the Peaceful Utilization of Atomic Energy and the Protection against its Haz-ards (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)
EMVG		Act on the electromagnetic compatibility of operating components (EMVG) of September 26, 1998 (BGBl. I, No. 64, p. 2882), most recently changed by Article 51 of the act of June 23, 2021 (BGBl. I p. 1858)
WHG		Act on the regulation of the water household (Water resources act – WHG) of July 31, 2009 (BGBl. I p. 2585) most recently changed by Article 1 of the Act of January 4, 2023 (BGBl. I, p. 2771)
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)
Self-Surveillance Control Guideline	(1996-02)	Control of the self-surveillance regarding radioactive emissions from nuclear power plants of February 5, 1996 (GMBl. 1996, No. 9/10, p. 247)
KTA 1202	(2017-11)	Requirements for the testing manual
KTA 1401	(2017-11)	General requirements regarding quality assurance
KTA 1501	(2022-11)	Stationary system for monitoring the local dose rate within nuclear power plants
KTA 1502	(2022-11)	Monitoring volumetric activity of radioactive substances in the inner atmosphere of nuclear power plants
KTA 1503.1	(2022-11)	Monitoring the discharge of radioactive gases and airborne radioactive particulates; Part 1: Monitoring the discharge of radioactive matter with the stack exhaust air during specified normal operation
KTA 1503.2	(2022-11)	Monitoring the discharge of radioactive gases and airborne radioactive particulates; Part 2: Monitoring the discharge of radioactive matter with the vent stack exhaust air during design-basis accidents
KTA 1503.3	(2022-11)	Monitoring the discharge of radioactive gases and airborne radioactive particulates; Part 3: Monitoring the non-stack discharge of radioactive matter
KTA 1505	(2022-11)	Suitability verification of the stationary measurement equipment for radiation moni-toring
KTA 1507	(2022-11)	Monitoring the discharge of radioactive substances from research reactors
DIN EN ISO 11929-1	(2021-11)	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
DIN EN 60529	(2014-09)	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989 + A1:1999 + A2:2013); German version EN 60529:1991 + A1:2000 + A2:2013

DIN EN 60529 Corrigendum 1; VDE 0470-1 Corrigendum 1:2017-02
Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989 + A1:1999 + A2:2013); German version EN 60529:1991 + A1:2000 + A2:2013, Corrigendum to DIN EN 60529 (VDE 0470-1):2014-09, (IEC 60529 Edition 2.2 Corrigendum 2:2015); German version EN 60529:1991/AC:2016-12

DIN EN 60529 Corrigendum 2; VDE 0470-1 Corrigendum 2:2019-06
Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989/A2:2013/COR1:2019); German version EN 60529:1991/A2:2013/AC:2019-02

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