

Safety Standards

of the

Nuclear Safety Standards Commission (KTA)

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**

(Überwachung der Ableitung gasförmiger und an
Schwebstoffen gebundener radioaktiver Stoffe)

Teil 2: Überwachung der Ableitung radioaktiver Stoffe
mit der Kaminfortluft bei Störfällen)

The previous versions of this safety
standard were issued in 1999-06, 2013-11 and 2017-11

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

Editor:

KTA-Geschaeftsstelle

c/o Bundesamt fuer die Sicherheit der nuklearen Entsorgung (BASE)

Willy-Brandt-Str. 5 • 38226 Salzgitter • Germany

Telephone: +49 (0) 30 184321-2907

KTA SAFETY STANDARD

November
2022

Monitoring the Discharge of Radioactive Gases and Airborne Radio-
active Particulates
Part 2: Monitoring the Discharge of Radioactive Matter with the Vent
Stack Exhaust Air During Design-Basis Accidents

KTA 1503.2

Previous versions of this safety standard: 1999-06 (BAnz No. 243b of December 23, 1999)
2013-11 (BAnz AT 17.01.2014 B3)
2017-11 (BAnz AT 05.02.2018 B3)

Contents

Basic Principles	5
1 Scope	5
2 Definitions	6
3 Measurement Objects and Measurement Procedures	7
3.1 General Requirements	7
3.2 Radioactive Noble Gases	7
3.3 Radioactive Substances Bound to Aerosols and Radioactive Gaseous Iodine	8
4 Sampling	9
4.1 Radiation Protection and Sampling Points	9
4.2 Sampling Equipment and Sampling Procedures	9
5 Design and Construction of the Monitoring Equipment	9
5.1 Design and Installation	9
5.2 Statistical Certainty and Detection Limit	10
5.3 Displaying and Recording the Measured Values of Stationary Measurement Equipment	10
5.4 Testability	11
6 Maintenance of the Monitoring Equipment	11
6.1 Servicing and Repair	11
6.2 Tests and Inspections of Stationary Monitoring Equipment	11
6.3 Tests of the Mobile Measurement Equipment	12
7 Documentation of Measurement Results	13
7.1 Flow Chart	13
7.2 Extent of Documentation	13
Appendix A Regulations Referred to in this Safety Standard	19

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:

KTA-Geschaeftsstelle c/o BASE, Willy-Brandt-Strasse 5, D-38226 Salzgitter, Germany or kta-gs@base.bund.de

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 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 stationary and the mobile radiation protection instrumentation serves, among others, in protecting the persons inside and outside of the facility from ionizing radiation, and in ascertaining the specified normal functioning order of the equipment

- a) for keeping solid, liquid and gaseous radioactive substances within the provided enclosures,
- b) for handling and the controlled conducting of radioactive substances within the facility, and
- c) for monitoring the discharge of radioactive substances.

Concrete safety related requirements with regard to this instrumentation are specified in the safety standards of the series KTA 1500.

(3) The parts of safety standard KTA 1503 comprise the requirements regarding the technical equipment and additional organizational measures considered necessary with respect to monitoring the emissions of airborne radioactive substances into the environment of the power plant. These parts are, specifically:

- Part 1: Monitoring the discharge of radioactive substances with the vent stack exhaust air during specified normal operation,
- Part 2: Monitoring the discharge of radioactive substances with the vent stack exhaust air during design-basis accidents,
- Part 3: Monitoring the non-stack discharge of radioactive substances.

(4) Monitoring the discharge of radioactive substances contributes to fulfilling the requirements specified under Sec. 8 StrlSchG, and Secs 99, 102 and 103 StrlSchV, in accordance of which it is required

- a) that any exposure or contamination of man and environment must be minimized even to levels below the respective limit values specified in StrlSchG by taking into consideration the state of the art and by taking into account all circumstances of the individual situations (Sec. 8, para. (2) StrlSchG),
- b) that no radioactive substances are discharged uncontrolled into the environment (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 monitoring equipment must fulfill the requirements under Sec. 90 StrlSchV.

(5) In accordance with Sec. 107 StrlSchV, it is required that, in the event of design-basis accidents and emergencies, all necessary measures are initiated without delay in order to minimize the danger to life, health and material goods. In accordance with Sec. 106, para (2) StrlSchV, it is required that, in preparation for an effective damage control and mitigation, the necessary auxiliary aids are kept in readiness. Basis for the decision to take these measures as well for their type, extent and duration is, among others, the monitoring performed with the accident measurement equipment for detecting radioactive substances discharged with the exhaust air from nuclear power plants.

This monitoring of the discharge of radioactive substances serves in fulfilling the following tasks:

- a) Providing data regarding the type and activity of the radioactive substances discharged as a consequence of a design-basis accident, and
- b) Providing information needed for the decisions regarding necessary protective measures.

(6) It is decisive for the design of the instrumentation to know what information must be available during design-basis accidents and for what conditions the necessary measurement equipment must be designed. With respect to specified normal operation, this means that the required display ranges and the ranges of the influencing parameters must be expanded.

(7) By monitoring the activity of the discharged radioactive substances (emission monitoring) in combination with meteorological measurements and dispersion analyses on the one hand and direct measurements in the environment (immission monitoring) on the other, statements can be made about the radiological effects on the environment of the power plant. Whereas, during specified normal operation, the essential data is acquired by emission monitoring – here the data derived from immission monitoring lie within the margin of fluctuation of the natural radiation –, it is the immission monitoring that becomes ever more important during design-basis accidents because it enables identifying the radiological effects. In extreme cases, immission monitoring is practically the only measurement method to identify the radiological effects on the environment because the radioactive substances could also be discharged via other ways than those provided for discharging radioactive substances.

(8) The requirements specified in the present safety standard are intended to ensure that, in the case of those design-basis accidents where the results from emission monitoring are still of greater significance, this emission monitoring can be performed in a reliable way.

(9) The equipment required for fulfilling these tasks are subdivided as

- a) stationary measuring or sampling equipment, and
- b) mobile measurement equipment deployed for the nuclide specific measurements in the course of determining the activity of the cumulative samples specified under Section 3.

1 Scope

(1) This safety standard shall apply to the equipment for monitoring the discharge of gaseous radioactive substances and radioactive substances bound to aerosols with the vent stack exhaust air during and after design-basis accidents in nuclear power plants with light water reactors.

(2) The requirements specified in the present safety standard for the instrumentation take only those design-basis accidents into account where gaseous radioactive substances and radioactive substances bound to aerosols are discharged through the vent stack. In the case of design-basis accidents for which this monitoring of emitted radioactive substances cannot be assured, the monitoring must fall back on the measurements performed with the framework of environmental monitoring (immission monitoring).

(3) Measurement equipment for serious events that require plant-internal accident management measures are not within the scope of the present safety standard.

Note :

Plant-internal accident management measures may necessitate other requirements than those specified in the present safety standard.



2 Definitions

(1) Discharge rate

Discharge rate is the quotient of the amount of activity discharged and the time span in which this discharge occurred.

(2) Discharge of radioactive substances

Discharge of radioactive substances is the intentional release of liquid radioactive substances bound to aerosols or of gaseous radioactive substances from the power plant along paths provided for this purpose.

(3) Specified normal operation

Specified normal operation encompasses

- Operating processes for which the plant, assuming the able function of all systems (fault free condition), is intended and suited (normal operation);
- Operating processes which occur in the event of a component or system malfunction (fault condition) as far as safety related reasons do not oppose continued operation (abnormal operation);
- Maintenance procedures (inspection, servicing, repair).

(4) Decision threshold

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

Note:

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

(5) Release of radioactive substances

Release of radioactive substances is the escape or leakage of radioactive substances from the intended enclosures into the power plant or the environment.

(6) Cumulative beta activity

The cumulative beta activity is the activity determined by an integral measurement of the beta particles emitted by a radioactive substance and setting this value into relation to the reference nuclide used for calibrating the measurement equipment.

(7) Overall loss factor

(sampling airborne radioactive substances)

The overall loss factor is a correction factor to be applied when determining the discharge of airborne radioactive substances. It is, essentially, comprised of factors related to changes of the activity concentrations of airborne radioactive substances caused by

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

(8) Iodine fraction

An iodine fraction is that fraction of the iodine that, on account of its physical and chemical characteristics, can be selectively collected in special filter and absorption materials. According to the current state of science and technology these are the following fractions: elementary iodine, iodine bound to aerosols

and organically bound iodine. Together, elementary iodine and organically bound iodine are referred to as gaseous iodine.

(9) Measurement equipment

Measurement equipment includes the entirety of all measuring and auxiliary devices required for determining a measurement parameter, for passing on and adjusting a measurement signal and for displaying the measured value as an image of the measurement parameter.

(10) Measurement medium

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

(11) Detection limit

The detection limit is a calculated value for a measurement parameter (e.g., activity, activity concentration, specific activity) meant to be compared to a predetermined reference value to help decide whether or not the measurement procedure is suitable for a particular measurement task.

Note:

- Detection limits are determined in accordance with DIN EN ISO 11929-1.
- Application examples are given in report KTA-GS 82.

(12) Design-basis accident

A design-basis accident is a chain of events upon the occurrence of which the plant operation or the work task cannot be continued for safety-related reasons and which, with respect to the plant operation, was considered in the plant design or for which, with respect to the work task, precautionary protective measures must be provided.

(13) Accident overview display equipment

Accident overview display equipment are those parts of the accident display equipment which display the essential measurement parameters describing the condition of the plant during design-basis accidents.

(14) Monitoring

Monitoring is a collective term for the various types of a controlled determination of physical parameters; monitoring includes comparing the results with previously specified values.

Note:

Monitoring is performed, e.g.,

- by continuous measurements, or
- by analyses of samples (e.g. in a laboratory), or
- by a combination of selective measurement values, and

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

(15) Wide range display equipment

The wide range display equipment are those parts of the accident display equipment which display the measurement parameters specific to information about whether or not the plant parameters are approaching the design values of the activity barriers and which, in case these design values are exceeded, display the further development of those plant parameters.